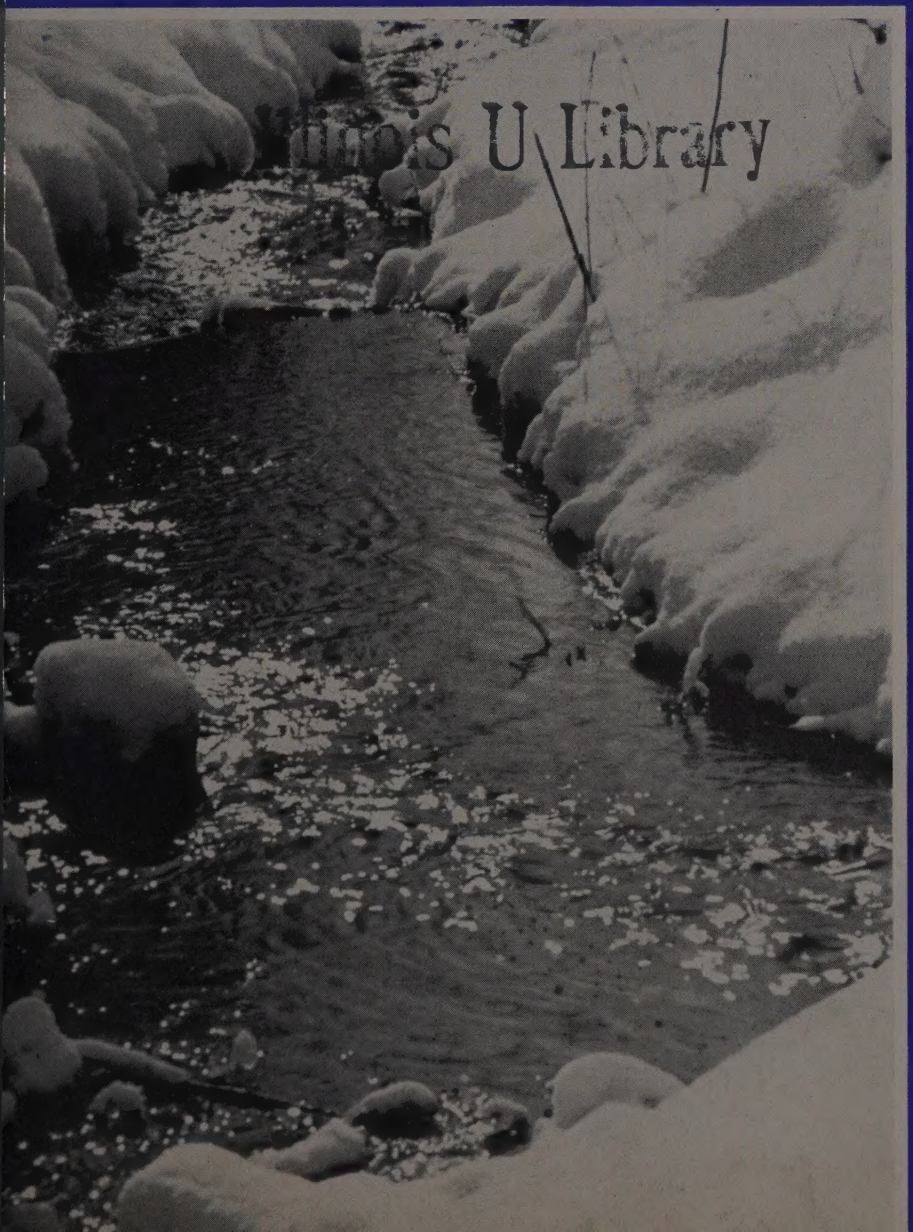
The Illinois Technograph

MARCH, 1949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TWENTY-FIVE CENTS

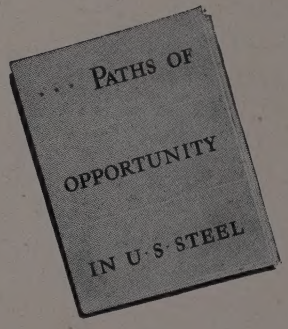
Thousands of Acres of Southern Farm Land Revitalized

Tennessee Coal, Iron and Railroad Company plays important role in task

FOR years, the devastating "one-crop system" robbed vast acreages of southern soil of the vital mineral elements which support plant growth. Cotton or tobacco raised in the same fields year after year had reduced the fertility of many southern farms to the point where the annual yield hardly paid for the seed and labor that went into production.

Among the things that agricultural leaders found in their efforts to build up southern agriculture was that Basic Slag —a by-product of open hearth steel, as manufactured at the Ensley (Alabama) Works of the Tennessee Coal, Iron and Railroad Company, a subsidiary of United States Steel Corporation — contained several important minerals, including phosphorus and lime. These elements are needed to grow bountiful crops and high beef and milk producing pastures.

Today, Basic Slag is in wide use as a convenient, economical soil builder. Together with the other soil-building programs of the agricultural agencies, it has helped the southern farmer to prosper.



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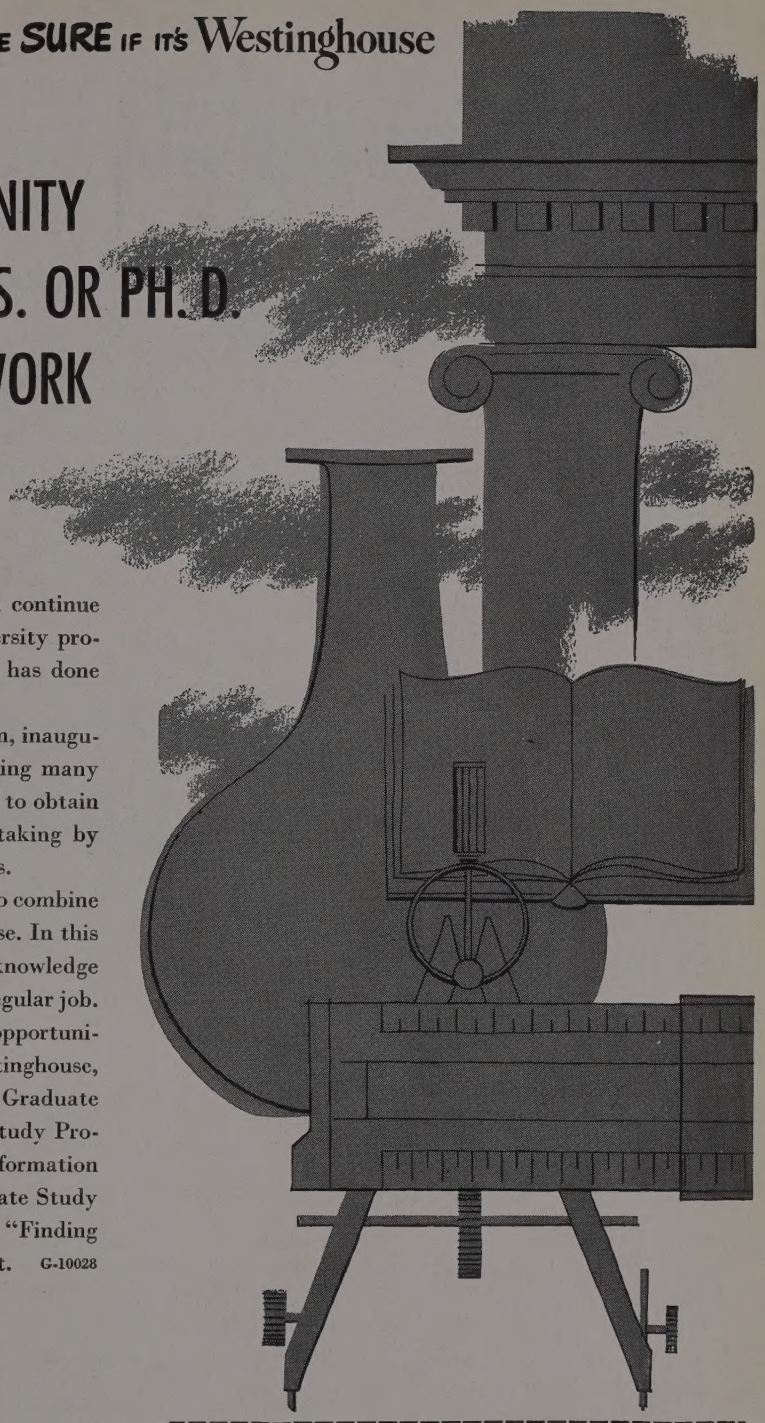

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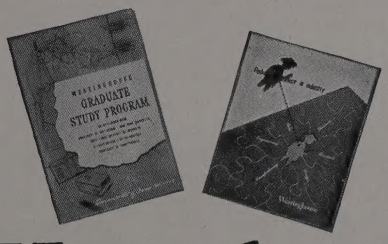

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New Developments

By Leonard Ladof, E.E. '49
Ken McOwan, M.E. '49
Henry Kahn, Ch.E. '50

Safety First

Development of explosion-proof electric motors has in the last few years received a great deal of attention from designers, in order to satisfy the demand for safer and more efficient motors in coal mines and industries where dust accumulation may cause explosions.

Enclosed motors seem to be the answer; however, the standard enclosed motor, due to the insulation and lubricant used, had to be equipped with a cumbersome cooling system. This problem has now been overcome by the use of silicone insulated winding and silicone grease.

These silicone resins can withstand high temperature and a great deal of wear. The value of this type of motor is best illustrated by comparing the physical properties of this silicone insulated motor to the conventional one.

The efficiency, power factor, and torque are about the same as that of open motors of the same rating, and it is only sixty per cent as heavy as a Class A insulated motor.

Switch Heater

A new type of heater has been devised that will keep railway switches from freezing in the coldest weather. The use of such devices not only reduces the number of men needed to keep switches clear during bad weather to almost nothing, but assures clear switches without the uncertainty caused by the human element in this important matter.

Ceramic Crystals

The use of ceramic elements to replace the Rochelle salts type of crystals has been announced by the Astatic corporation of Conneault, Ohio. The most common use of the elements is in microphones and phonograph pickup arms. The features of the cartridge are its independence of high ambient temperatures, ruggedness, and resistance to moisture. Rochelle salt crystals are fragile and decompose at temperatures above 135° F.

The frequency response of the unit is essentially flat from 30 c.p.s. to 10,000 c.p.s. When employed in a microphone the output level is —62 db. into a load impedance of 5 megohms. The pickup cartridge operates into a similar load, and has a needle pressure of less than one ounce.

The Latest in Tape Recorders

A new tape recorder, scheduled for delivery in early 1949, has been announced by the Fairchild Recording Equipment corporation of Jamaica, New York.

One of its outstanding features is its 15 inches per second tape speed. The high fidelity performance, formerly thought possible only at 30 inches per second, is still maintained. Recording time for any specific amount of tape is doubled, and the operating speed of the equipment is reduced by this low tape speed. This results in lower costs of operation, and nicer controls of starting, stopping, spotting, and editing.

The Fairchild tape recorder doubles recording time of standard tapes while maintaining high fidelity performance.

In numerous tests, the finest ears have been unable to detect the difference in an instantaneous A-B test in switching between the monitoring of a live studio program and the same program from the Fairchild tape recorder. Tests also show better than 60 db. signal-to-noise ratio with a maximum total harmonic distortion of two per cent.

Other features of the instrument include plug-in type construction, both mechanical and electrical, for uninterrupted service; interlock system to prevent accidental erasing; volume indicator for reading recording level, etc; adjustment of playback head during operation; and automatic control in event of tape break.

Ford Truck Conversion

The Marmon - Harrington company Inc., of Indianapolis, has announced a complete new line of all-wheel-drive converted Ford trucks to be known as the "Q" series. The trucks are especially engineered and powered for heavy-duty service which has been proven too difficult or impossible for trucks of conventional drive. They promise to be particularly suited for oil field and pipeline work, mining and logging operations, construction and maintenance of roads, airports, bridges, dams, farming, and other types of off-the-road services.

In converting the F-7 models, (Ford's new heavy-duty truck, powered by the big 145 horsepower engine), Marmon-Herrington makes the following changes to the "Q" series:

1. Original front axle assembly replaced by new front driving axle.

2. New two-speed auxiliary transmission of Marmon-Herrington design provides a total of ten forward speeds and two reverse. The final low reduction of 89.215 to 1 gives extreme tractive power for off-the-road operation.

3. Steering assembly and brake connections necessarily changed.

4. Frame is lengthened and reinforced, and a third driving axle installed on six-wheel-drive models.

5. Tires are replaced for increased flotation, when necessary.

"The Blind Shall See"

A new electronic letter recognition system to enable blind persons to read was recently developed by RCA as a result of extended research for the Office of Scientific Research and Development and the Veterans Administration.

This system consists of a scanning unit, a selector, and a loudspeaker. As the user moves the scanning device along a line of type, a miniature cathode ray tube explores each letter with eight vertically arranged spots of light.

Each of the black letters actuates a different number of impulses, which are electronically counted and noted on the selector unit. Each set of numbers actuates a magnetic tape recording, which is made audible by reproducing through a loudspeaker. This device is limited to the 26 letters of the alphabet and a few commonly used words.

This model is still in its experimental stage but a possibility exists that this instrument can also be used to translate coded patterns, such as those which form the basis of teletype messages.

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the Illinois Technograph

Volume 64 **Number 6**

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OUR COVER

This "babbling brook" snow scene is not the "Boneyard," as most of you might think. The picture was taken in February, 1946, in Kassel, Brasselsberg, Germany, while the photographer, C. M. McClymonds, was on duty with the Army Engineers.

Operation: South Pacific

By Connie Minnich, C.E. '51

(ILLUSTRATIONS BY THE AUTHOR)

Out of the ruins of the past war have arisen new examples of engineering ingenuity that have violated every rule in the Engineer's Hoyle, some of which have been fundamental theorems of engineering ever since the first caveman threw a log across a stream and, by the grace of St. Pat, became the first engineer.

Bailey bridges, pontoon structures coral airfields—the list of engineering feats of the past war runs to infinity. Obstacles of climatic conditions, topographical features, and availability of building materials met extremes from the poles to the equator. How American engineers surmounted these obstacles, and how they created many things out of practically nothing on the old necessity-is-the-mother-of-invention rule makes a story worth the telling from Life to Engineering News-Record.

Globe-trotting became an occupation for the armed forces who fought the war in the South Pacific; or, as one Seabee officer expressed it, "Too damn much water and too little land." Their military tactics necessitated such speed and systematic cooperation that things had to be accomplished with only the impossible "taking a little longer."

Probably one of the greatest feats that came out of this theater was the highly-secret operation known as "Red Hill." From start to finish, the project, done by private corporations under government contract, was entirely experimental since no construction of this particular type had been attempted before.

The story began early in 1940. At that time the United States government had just completed its coastal and territorial defenses in the Pacific to the tune of 65 million dollars worth of work done by PNAB (Contractors, Pacific Naval Air Bases), a combo of three large corporations: the Hawaiian Dredging Company, Turner Construction of New York, and the Raymond Concrete Pile Company, also of New York. In the new contract of 1940 given by the Navy department to PNAB appeared an unexplained paragraph entitled Project 16.

"Underground Fuel Storage, $4,000,000."

An explanation soon followed. The Navy wanted to store oil—four million barrels of it—for the Pacific fleet somewhere in the vicinity of Pearl Harbor. They wanted it stored in underground bombproof tunnels.

CONNIE MINNICH

"I'm in engineering because I love it!" Connie Minnich emphatically answers queries about her north campus habitudes.

Already an assistant editor of the Technograph, Connie is completing her sophomore year in civil engineering. Proof of her engineering interest is her active participation in the A.S.C.E., I.T.E., Mu-San, a sanitary engineering society, and the Illinois Society of Professional Engineering; also, she desires to do graduate work in hydraulics or sanitary engineering at Harvard.

The problem looked simple enough on paper, but locating such a storage place around Hawaii was difficult. The ground was practically all "puka-puka," the native for the lava deposits of hard basalt and volcanic ash spliced with bubble holes that ranged from a pinpoint in size to caverns as big as barns and underground streams that threaded the whole undersurface.

After a month of test borings, a low ridge known as Red Hill was chosen as the site of tunneling; two miles from the harbor, it was all and more than PNAB could ask for, since it was beautifully free of the "puka" ground and composed of fairly soft rock that would make tunneling a fairly simple operation.

Red hill and Pearl harbor are easily located on the Hawaiian island of Oahu.

Now the conferences began. Authorities, among them geologists, tunneling and hydraulic experts, the best that America had, were called in for consultation. The original idea had been to carve a system of horizontal vaults out of the side of the mountain; elaborate plans and specifications were laid out on this basis. However, it was a short conversation over a dinner table one night that developed the final plans. Two of the resident engineers outlined a process of tunneling which, with its simplicity and economy, floored even the Naval department, which had long since grown accustomed to the sudden brainstorms of PNAB. Immediately all plans were halted and gears shifted within two weeks time to meet the new specifications.

History books and other documents will hand down to posterity the record of the politician's and militarist's past war, but what about the engineer's chronicle? The following article, reviewing very briefly the highlights of engineering feats in the South Pacific theater, is the beginning of a series of such articles that give the engineer behind the man behind the gun a pat on the back.

These new plans now called for vertical tunnels—a series of wells, each double the diameter of the original tunnels and each 300 feet deep. Operations began with the boring of a horizontal tunnel the length of the mountainside. Smaller tunnels were cut off from the sides of this passage which eventually became the main connecting tunnel for all the wells. On top of the ground, meanwhile, shafts were sunk through the soft strata down to the point where they met these small side tunnels. Each shaft thus formed was the centerline of a vault.

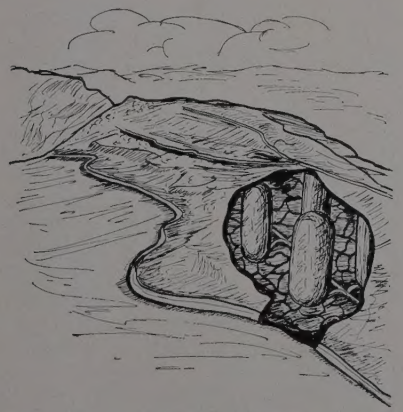
In the following tunneling operations, the excavated rock and dirt was dropped down the center shaft to the small side

tunnel where it was taken out through the main passageway by a system of conveyors. This nifty use of gravity to eliminate the cut alone saved the Navy hundreds of thousands of dollars in hauling expenses; for, as fast as the rubble came out of the side of the mountain, it was eaten up by Army and Navy demands for road-grading material and concrete aggregates—about five million tons of it.

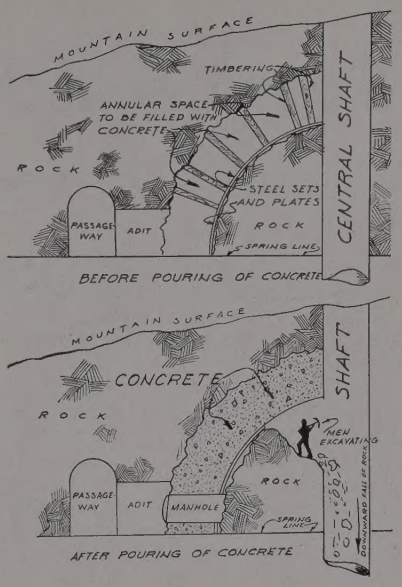
Excavation work now carved a form in the mountain in the shape of a huge inverted bowl stemming from a point in the center shaft 100 feet down from the ground surface (for bombproofing purposes) to the springing line of the vault. This cavity—the upper dome of the vault—had to be a perfect mould for the concrete pourings and constituted the most difficult part of the operation with its precision cutting and pouring.

The whole space required timber bracing due to the fairly soft rock. Lined on its lower surface with firmly welded steel plates, the "bowl" also had an elaborate network of reinforcing rods which were "floated" with accessory wires attached to the rock ceiling and the steel floor. Concrete was then poured steadily from a batching plant on top of the mountain down through a pipeline in the center shaft and distributed evenly throughout the mould. As fast as the concrete came, work crews ribbed out the timbering directly above it. The whole pouring operation of this upper dome took 70 hours.

After the concrete had set, excavation now began on the underside of the "cup," with the crews widening the center shaft in a V or funnel shape so that the rock debris rolled right down to the edge and then down the shaft to the heavy-duty belt conveyors far below. After the cylinder of the vault and the bottom of the dome had been hollowed out, the whole rock surface was grouted to seal off all cracks. Some



A cutaway of Red hill shows the wells as they appear beneath the ground.



The dome of a well is shown before and after pouring of the concrete.

of the puka holes that had been found (the largest in this mountain was only the size of a trunk) were filled with concrete. The bottom dome, or invert, was then cast. Next, fabricated steel rings were assembled for the skeleton of the circumferential framework and, as these progressed upwards to meet the spring line of the upper dome, the welding crews followed and put on form plates. After these came the actual concrete pouring. After hardening, the concrete was prestressed to meet the tremendous pressure of the oil which otherwise would cause the plate seams to burst with resulting leaks. This was done by forcing grout under heavy pressure, into the space caused by shrinkage of the concrete from the form plates while it was setting.

Final testing for leaks was accomplished by a rather unique method. The finished vault was filled to the brim with water till it rose through a small pipe in the top. If in twenty-four hours the water level in the pipe dropped only half an inch, the test was deemed unsatisfactory. A system of indicator pipes leading up from the bottom passed through the plating at intervals where they were open. A hundred-pound pressure was put through the pipes and as the water level slowly rose again, any leaks were located by bubbles on the surface of the water. A crew of welders floating around on the surface of the water would locate a leak, signal the ground crews to lower the water level a bit, then repair the leak.

Final construction on the vault consisted of the stopping up of the original shaft with concerte. All other vertical entrances except the main passageways were wedged in solidly with eight-ton plugs.

Even though the Red Hill operation was important as a means of supply of the life blood of the Pacific fleet, equally as important was the undertaking of the mass construction of air fields on many of the islands that dotted the South Pacific. Part of this project was completed by the PNAB before the Pearl Harbor episode. After the commencement of the war, however, the U. S. Naval Construction Battalions, or "Seabees" as they were called, took over the work.

For the most part, these fields were constructed of materials native to the surrounding area, although in some cases, concrete and steel were employed. The most abundant source of material was coral. Although not the best possible surfacing material, coral served very well even under the heaviest of bombers; and, in some cases, it actually proved superior to concrete under the hot and moist climatic conditions.

In one instance on an airfield on Guadalcanal, the surfacing was a perforated steel mat on a fairly soft foundation. The first mat required constant repair; finally it broke down and had to be replaced by a second. Eventually, the second wore down, too, mainly because of uneven settling of the foundation. This was comprised of soft black silt that beat up to a thick foamy mud under the daily thumping of tropical rains, and which most of the time was little more than a swamp. Another runway in the adjacent vicinity was constructed by using coral for surfacing and the foundation was built in the following manner: first, a network of drainage ditches running in both directions was dug; the soil was compacted as much as possible; this was then covered with a four-inch layer of noncapillary earth to seal the mud; on top was spread and packed down a four-inch layer of gravel; finally, the four-inch layer of coral was spread and compacted. Even at the very end of the war, this coral runway was still giving excellent service on this footing.

Coral, as usually used, was mixed with a small percentage of clay and required a setting period of three days. During this time, the coral seemed to "come alive" and have certain expansions, contractions, and movements that caused the construction crews to tab it as "live" coral. These queer properties seemed to cause it to result in a very compact slab surface.

The heavy tropical rains presented the biggest problem—drainage. A 3½ per cent grade was the general rule although some runways were constructed with alternate sloping grades of 1½ per

(Continued on page 32)

Know Your Automobile

By J. C. Bassie and C. M. McClymonds

Part II

Everyone seems to have quite definite ideas about the car he desires, but very few of the people one talks to really know enough about the car they love to accurately judge whether this car meets and fulfills their needs. In fact, from the number of people who say, "I like that new ———— convertible," without having a better reason than the fact that it costs more money than they will ever be able to spend on a car, the need to explain to them that their needs are in contrast with their desires is quite apparent.

The basic thing to consider when purchasing a new car is the amount of driving one expects to do. For those who drive less than 5,000 miles per year, perhaps a car isn't needed at all. If the mileage requirements are less than 10,000 miles per year, a car may be needed, but the smaller, less-expensive car is the wisest choice. Only for those who drive more than 20,000 miles per year should the large expensive car be considered.

At this point it should be apparent that this article is not intended for the "prestige" car buyer. Instead, it is an attempt to study the basis for selecting, on technical principles, the best car from the standpoint of economics for the needs and desires of the prospective motorist.

The reason for the preceding breakdown on a mileage basis is to keep in mind that the only fair economical cost analysis is on a cost-per-mile-operated base. Naturally, if one gets an expensive car which uses more fuel per mile plus the high first cost, high insurance rates, high depreciation, high taxation, and high maintenance costs, the mileage driven must be very high to bring the cost per mile into line with that for a less expensive car driven fewer miles.

To refer back to the preceding article ("Know Your Automobile," Technograph, January, 1949), it was shown that the horsepower required varies with the cube of the speed. To carry this one step further, it may be demonstrated that, at speeds of less than 50 miles per hour, this horsepower is nearly the same for all cars. Since the horsepower required is one of the determining factors of what the fuel consumption will be, most cars are on an equal footing for judgment if over two-thirds of the miles driven are at speeds less than 50 miles per hour. If the requirements fall into this category, two more factors must be known. First, the fuel consumption per horsepower (which most manufacturers decline to furnish), and second, the degree to which the driver accelerates his car. This latter is usually a very difficult factor to even try to guesstimate because of the fact that even in the city driving conditions will vary over wide limits. Therefore, the best thing to do is to attempt to find the lightest and lowest-powered car that will meet the riding and driving requirements so the cost of acceleration will be minimized.

To generalize, long trips at high speeds should entitle one to make the choice of a heavy, high-powered car for the sake of riding comfort. To further simplify this discussion, some of the basic points to be considered are listed with their effects, both pro and con.

WEIGHT—Increases the riding comfort and frictional forces with the road, making the car safer. It also increases the power required for acceleration, thus increasing fuel consumption and the inertia forces in turning and stopping.

SIZE — Exterior: determines the space required for maneuvering and parking, and the necessary size of the garage. Naturally, a small car is best suited for easy handling in city traffic. Interior: determines passenger comfort and the capacity of the car. A club coupe or similar body style is always lacking in leg and head room in the back seat. The height of the seats, as well as the width, is important for riding ease. Today's dealers are willing for the prospective buyer to try the seats for size.

WINDOW AREA—This is only an approximate index of the visibility from the inside of the car. Seat height, window slope, and window-to-passenger relationships also affect the visibility. In most of the new cars, an outside mirror is more of a necessity than an accessory in order for the driver to obtain a clear view of the conditions to the rear of the car. Another point to check is the field of vision that the rear seat passengers have when the front seat is carrying its normal capacity of passengers.

BRAKE LINING AREA—A light braking load (pounds of car weight per square inch of brake lining), is usually a good index of cool and subsequently safe braking. It will also increase the life of the linings.

TIRE SIZE—Large, oversized tires (with increased cross-sectional area rather than diameter) give a softer ride, longer tire life, and greater safety. The softer ride is due to the fact that more load is carried by the air in the tire and less by the tire sidewall. The greater life and safety is due to the greater area in contact with the road and thus, for the same frictional force, the unit stress in the tire is less. This decrease in unit stress reduces the tendency for the so-called "black mark" skids, which are the result of rubber shearing off of the tire.

HORSEPOWER — This factor is the most important in the determination of the top speed of the car, the second being the air resistance or drag.

TORQUE — This is the quantity which determines the acceleration rate of the car and the hill climbing ability. The exact manner of its effect was discussed in the preceding article, but it can be noted from the accompanying specification chart that the maximum torque is usually found at engine speeds from 1,200 to 1,600 r.p.m. for six-cylinder engines and at speeds from 1,600 to 2,200 r.p.m. for eight-cylinder engines. Other things being equal, it is apparent that a six-cylinder car can accelerate faster below 35 m.p.h. than an eight, but the eight can accelerate faster at speeds above 40 m.p.h. This should be kept in mind when making the choice, depending on one's speed requirements.

REAR END RATIO—This, as previously explained, affects the acceleration, the top speed, and the economy of fuel that may be expected. It was quite common before the war for the purchaser to make a choice between three different ratios: one of approximately 3.7:1 for economy, one of approximately 4.5:1 for performance and hill climbing, and a third of approximately 4.1:1 for all-around utility. The parenthesized ratios are indicated as optional.

TRANSMISSIONS — The type of transmission available with the car is a controlling influence on the choice of

(Continued on page 11)

MAKE	SERIES	NO. CYLINDERS	BORE (IN.)	STROKE (IN.)	PISTON DISPLACEMENT (CU. IN.)	MAXIMUM BRAKE HORSEPOWER	MAXIMUM TORQUE (FT.-LB.)	STANDARD COMPRESSION RATIO	REAR-END RATIO	WHEELBASE (IN.)	FRONT TREAD (IN.)	REAR TREAD (IN.)	BRAKING AREA (SQ. IN.)	WINDOW AREA (SQ. IN.)
BUICK	50	8	3 3/32	4 1/8	248.1	115 @ 3600	212 @ 2000	6.6:1	4.46:1	124	59 1/8	62 3/16	161 1/2	3600
	70	8	3 1/16	4 5/16	320.2	150 @ 3600	280 @ 2000	6.9:1	4.46:1	129	59 1/8	62 3/16	207 1/2	3600
CADILLAC	61	V-8	3 13/16	3 5/8	331	160 @ 3800	312 @ 1800	7.5:1	3.77:1	126	59	63	220	3494
	62	V-8	3 13/16	3 5/8	331	160 @ 3800	312 @ 1800	7.5:1	3.36:1 (H)	126	59	63	220	3494
	60	V-8	3 13/16	3 5/8	331	160 @ 3800	312 @ 1800	7.5:1		133	59	63	220	3477
	75	V-8	3 9/16	3 5/8	331	160 @ 3800	312 @ 1800	7.5:1	4.27:1	136 1/4	58 1/2	62 1/2	233	2930
CHEVROLET		6				90		6.6:1		116	57	58 3/4		
CHRYSLER	C 38	6	3 7/16	4 1/2	250.6	114 @ 3600	204 @ 1200	6.6:1	3.9:1	121 1/2	57	60 9/32	173 1/2	
	C 39	8	3 1/4	4 7/8	323.5	135 @ 3400	270 @ 1600	6.7:1	3.91:1	127 1/2	57 13/16	61 9/16	189 1/2	
DE SOTO	S 11	6	3 7/16	4 1/4	236.6	109 @ 3600	192 @ 1200	6.6:1	3.9:1	121 1/2	57	60 9/32	173 1/2	
DODGE	D 24	6	3 1/4	4 5/8	230.2	102 @ 3600	184 @ 1200	6.7:1	4.1:1	119 1/2	57	60 9/32	173 1/2	
FORD		6	3.3	4.4	226	95 @ 3600	180	6.8:1		114	58.08	60		
		V-8	3.187	3 3/4	239	100 @ 3600	180 @ 2000	6.8:1		114	58.08	60		
FRAZER		6	3 5/16	4 3/8	226.2	100	180 @ 1400	7.3:1	4.09:1	123 1/2	58	60	175.7	
HUDSON		6	3 9/16	4 3/8	262	121 @ 4200	200 @ 1600	6.5:1	4.1:1	124				
		8	3	4 1/2	254	128 @ 4200	198 @ 1600	6.5:1	4.1:1	124				
KAISER		6	3 5/16	4 3/8	226.2	100	180 @ 1400	7.3:1	4.09:1	123 1/2	58	60	175.7	
LINCOLN		V-8	3 1/2	4 3/8	336.1	152 @ 3600	265 @ 1800	7.0:1	3.9:1	121	58 1/2	60	219.8	2527
	COSMOPOLITAN	V-8	3 1/2	4 3/8	336.1	152 @ 3600	265 @ 1800	7.0:1	3.9:1	121	58 1/2	60	219.8	3208
MERCURY		V-8	3 3/16	4	255.4	110 @ 3600	202 @ 1800	6.8:1	4.27:1	118	58 1/2	60	179.12	2527
NASH	600	6	3 1/8	3 3/4	172.6	82 @ 3600		7.0:1	4.4:1	112	54 11/16	59 11/16		
	AMBASSADOR	6	3 3/8	4 3/8	234.8	112 @ 3600		7.02:1	4.1:1	121	54 11/16	60 1/2		
OLDSMOBILE	76	6	3 7/32	4 3/8	257.14	105	202	6.5:1	4.1:1	119 1/2	57	59	159.8	2752
	88	V-8	3 3/4	3 7/16	303.73	135	263	7.25:1	3.23:1 (H)	119 1/2	57	59	191.7	2752
	98	V-8	3 3/4	3 7/16	303.73	135	263	7.25:1	3.23:1 (H)	125	58	61 1/2	191.7	3070
PACKARD	DE LUXE	8	3 1/2	3 3/4	288	130 @ 3600	225 @ 2200	7.0:1	3.9:1	120				
	SUPER	8	3 1/2	4 1/4	327	145 @ 3600	266 @ 2200	7.0:1	3.9:1	120				
	CUSTOM	8	3 1/2	4 5/8	356	160 @ 3600	282 @ 2200	7.0:1	3.92:1	127				
PLYMOUTH	P 15	6	3 1/4	4 3/8	217.8	95 @ 3600	172 @ 1200	6.6:1	3.9:1	117	57	60 1/8	158	
PONTIAC	STREAMLINER	6	3 9/16	4	239.2	93 @ 3400	183 @ 1200	6.5:1	4.1:1	120	58	59	173	
	CHIEFTAIN	6	3 9/16	4	239.2	93 @ 3400	183 @ 1200	6.5:1	4.1:1	120	58	59	173	2779
	STREAMLINER	8	3 1/4	3 3/4	248.9	106 @ 3800	194 @ 2200	6.5:1	4.1:1	120	58	59	173	
	CHIEFTAIN	8	3 1/4	3 3/4	248.9	106 @ 3800	194 @ 2200	6.5:1	4.1:1	120	58	59	173	2779
STUDEBAKER	CHAMPION	6	3	4	170	80 @ 4000	134 @ 2000	6.5:1	4.1:1	112	56 1/4	54	148	2368
	COMMANDER	6	3 5/16	4 3/4	245	100 @ 3400	200 @ 1600	6.5:1	4.09:1	119	55	54	178	2368
	LAND CRUISER	6	3 5/16	4 3/4	245	100 @ 3400	200 @ 1600	6.5:1	4.09:1	123	55	54	178	2408

COMPARATIVE SPECIFICATIONS OF CURRENT PRODUCTION MODELS OF AMERICAN-MADE CARS
FROM DATA OBTAINED FROM THE MANUFACTURER
(BLANK SPACES INDICATE UNAVAILABLE INFORMATION) (2-1-49 - CMM)

The Coming Convocation

By Dale Glass, Ch.E. '49

On April 8, 1949, the slide rule boys will observe the launching of something new in the history of the University —the first annual all-engineering convocation, sponsored by the Engineering Council and the Illinois Technograph.

The objectives of this new venture are (1) to promote an active interest in the advancement of effective teaching at the University, (2) to honor members of the faculty in the various engineering departments, in particular, those who are chosen by vote of the students as the most effective teachers, and (3) to bring about a closer relationship among the faculty and the students.

President Stoddard to Speak

Because of his contributions to the educational field, our own president, Dr. Stoddard, has been chosen to deliver the main address at this first convocation in the University Auditorium. Sharing the spotlight with President Stoddard will be M. L. Enger, retiring

PRESIDENT STODDARD

dean of the College of Engineering, and W. L. Everitt, dean-elect of the College, who will each give a brief talk. The concluding feature of this event will be the presentation of awards to the engineering instructors chosen by the students for their effective teaching methods.

Classes to be Dismissed

Engineering students will be dismissed from their 10 o'clock classes on Friday, April 8, so that they will have the opportunity to hear President Stoddard speak and to learn the results of the effective teaching contest. Not until then will the results of the contest be announced.

Effective Teaching Defined

Just what is effective teaching? Here is what two professors and one student have to say about it. (In fairness to other instructors eligible for the contest, the instructors quoted have not been identified):

"The effective instructor is one who stimulates each student to learn, to think and to perform at his highest capacity." —Well-known M.E. instructor.

"Effective teaching should accomplish the following: (1) direct results — development of mental skills, development of confidence in ability to learn, acquisition of factual information, and (2) indirect results—appreciation of viewpoints of others, increase the horizon of interests, development of sense of individual responsibility, increase in capacity for self-direction and self-discipline. Direct results depend upon . . . knowledge of teaching methods and material on the part of the instructor. Indirect results depend upon the philosophies and personality of the instructor." —A popular E.E. instructor.

"A good instructor, in my opinion, is one who possesses an ability to teach. No matter what academic degree is held, the ability to teach consists of a few important points: primarily, a knowledge for one particular course or even one of subject matter beyond that required field of study, and secondly, the ability to communicate information to students. Among the basic necessities are an understandable speaking voice, a sense of humor, and a knack for improvising subject matter to correlate it with the present-day picture."—Wm. Peeples, editor, Daily Illini.

Contest Date

All junior and senior engineering students will have the opportunity to cast three votes for their most effective instructors in any engineering department. Voting dates will be Wednesday through Friday, March 16 through 18, inclusive. The student may cast no more than one vote in any one department. (For this contest, mining and metallurgy are considered as separate departments.)

Location of ballot boxes:

Aero. E. — Office Transportation building.

Ag. E.—Office, Agricultural Engineering building.

Arch E.—Office, Architecture building.

Cer. E.—Office, Ceramics building.

Chem. E.—Office, Noyes laboratory.

Civil, Gen., DSSWV. E.—First floor, Engineering Hall.

Elec. E.—Office, E. E. R. L.

Eng. Physics—Office, Physics building.

Mech. E.—First floor, M. E. laboratory.

Min. and Met. E.—Office, Ceramics building.

(Previous information concerning the Convocation and Contest appeared in the February issue of the Technograph.)

A sample ballot appears on the next page.

A farmer and a professor were sharing a seat on a train. It was getting lonesome so the farmer started a conversation and they soon became a friendly pair.

"Let's have a game of riddles to pass the time," said the professor. "If I have a riddle that you can't guess you give me one dollar or vice versa."

"All right," replied the farmer, "but as you are better educated than I am, do you mind if I only give fifty cents?"

"OK," replied the professor, "you go first."

"Well, what animal has three legs walking and two legs flying?"

"I don't know. Here's your dollar. What's the answer?"

"I don't know either. Here's your fifty cents," answered the farmer.

* * *

A woman is a person who can hurry through a drugstore aisle 18 *inches wide without brushing against the tinware piled up there, and then drive home and knock off one of the doors from a* 12*-foot garage.*

* * *

"Willie, I'd like to go through one whole day without once scolding you or punishing you."

"All right mother, you have my consent."

Ballot for Effective Teaching Contest

SPONSORED BY

The Engineering Council and Illinois Technograph

Vote for one, two or three instructors in any engineering department listed below, but do not vote for more than one instructor in any one department

AERONAUTICAL	**CIVIL**	**PHYSICS**
AGRICULTURAL	**ELECTRICAL**	**MINING**
ARCHITECTURAL	**G.E.D.**	**THEORETICAL and APPLIED MECHANICS**
CERAMICS	**MECHANICAL**	
CHEMICAL	**METALLURGICAL**	

Name of Instructor — Department

1. _____

(SAMPLE BALLOT)

2. _____

3. _____

Don't spoil a ballot. Polls open Wednesday, Thursday, and Friday, March 16, 17, and 18. 8-12 a.m. and 1-5 p.m.

AUTOMOBILES . . .

(Continued from page 8)

rear end ratio, and the parenthesized "H" in the rear end ratio column illustrates those ratios furnished by the manufacturers employing the Hydramatic transmission. It was found that most people using an automatic or semi-automatic transmission find that they had to develop a steadier foot on the throttle than they had been using in the past on manual transmissions, or the transmission would have a tendency to "hunt." This hunting is less noticeable on the torque convertor than it is on the automatic transmission.

USEFUL CAR LIFE—For the past decade, it has been considered that the maximum useful life of most cars, without excessive maintenance costs, is about three and one-half years or 100,000 miles, whichever occurs first. The most desirable wearing-out of a car, from the economical point of view, is through usage, because it lowers the cost-per-mile-operated.

Beyond this, and with the help of the accompanying chart, perhaps those contemplating the purchase of a new car can make their own comparison of these basic points and come to a logical conclusion as to which car will be the best suited for the job.

Prof. (during the summer quarter): "That's five times this week that you have failed to turn in your assignments. Do you have any comments?"

Frosh: "Yes, sir. I'm certainly glad it's Friday."

* * *

Lieutenant (in the mess hall, roaring with indignation): "Who told you to put these flowers on the table?"

Sergeant: "The Colonel, sir."

Lieutenant: "Pretty, aren't they?"

* * *

Student: "Professor, can you help me with this problem?"

Professor: "I could, but I don't think it would be right."

Student: "I don't suppose it would, but let's take a shot at it."

* * *

Friend (to young wife contemplating divorce): "Remember, you took your husband for better or for worse."

Young Wife: "But I didn't take him for good, did I?"

* * *

Studies by the U. S. Bureau of Standards show that the average car gets 21 miles per gallon at 20 miles an hour, 16 at 40 miles an hour, 11 at 60 miles an hour, and 8 at 80 miles an hour.

Mrs. Jones was sitting in the breakfast nook shelling peas when she heard the back door open. Thinking it was her son, she called, "Here I am, darling."

Silence: Then a deep voice boomed, "This is not the regular iceman, Ma'am."

* * *

How's Your Tooter?

Automotive terms differ in many parts of the world. Here, for example, are American and British terms that mean the same thing:

A car horn is a tooter. A valve-grind job is a decoke job. The car transmission is a gearbox, the windshield a wind-screen. Gasoline is petrol, the generator is the dynamo, and the old-time rumble seat is a dickey seat.

The car hood is a bonnet, and when you talk of the car top in England you call *that* the hood. The trunk is a luggage boot.

You don't have a tire blow-out, you have a "burst." When you race the engine, you "rev up." The sidewalk is the pavement, and a paved road is a "built up."

A lug wrench for removing a car wheel is a wheelbrace. And the driver does not "step on the gas." He just "hits up."

Beginning Your Career in Engineering

By ELLIS DANNER

Associate Professor of Civil Engineering

Are you looking forward to graduation with a lot of employment questions still on your mind? If so, this article will provide you with a very helpful point-to-point analysis of factors that should be considered before making a decision. Also, some important suggestions on how to make the most of your first position are included.

Are you one of those young men who is about to complete his college training in engineering and who will soon begin an active career in engineering work? If you are, then you are probably struggling with some of the most difficult questions that you have had to answer during your college days. "What type of work would I like to do?" "Who offers the best opportunities?" "How much salary will I get?" "Where do I want to go?" "Which job shall I take?" "Why should I get an advanced degree?" "When will I find the answers to these questions?"

The answers to these and other similar questions must be worked out by you. You may receive advice and suggestions from others, but the final decisions are yours to make. Certain information which may be of assistance to you in making the proper start in your career in engineering is presented here for you to consider.

Where Shall I Begin My Career?

1. What engineering work is available?

Before you can compare jobs you must have some idea of what jobs are open to you. You will find the information about specific jobs in your college of engineering employment offices and through other employment contacts which you may establish. But you will also find it useful to know in a general way the various fields in which engineering services are used. The Engineers Joint Council made a survey of the engineering profession in 1946 and has published under the title "The Engineering Profession in Transition" extensive data on the distribution of engineers in the various fields and the ranges of salaries in those fields.

TABLE 1

Percentage Distribution of the Engineering Profession in 1946, by General Field of Employment.

General Field of Employment	Percentage
Total	100.0
Chemical	9.8
Civil	23.6
Electrical	25.2
Mechanical-Industrial	23.7
Mining Metallurgical	7.6
Other Engineering	6.5
Non-engineering	3.6

The membership of the engineering profession in the United States in 1946 was estimated to be 317,467. A projected estimate of the total for 1950 was 336,722. You are about to become a member of a very large profession with a wide variety of interests. First you may want to know how many engineers there are in your branch of the profession. Table 1 gives the percentage distribution in 1946 according to the general fields of employment. Table 2 shows the percentage distribution in 1946 according to major industry fields for each of the branches of engineering. Table 3 shows the percentage distribution in 1946 for the entire profession by class of worker and Table 4 by occupational status. The distribution for Tables 3 and 4 for the various branches of engineering may be found in the E.J.C. Report, but is not reproduced here.

From these tables you may determine the comparative demand for engineering services in the many phases of the profession and you may also learn of the various fields and occupations in which your engineering training may be used.

2. Should I get an advanced degree in engineering?

About the time that you are to receive your bachelor's degree in engineering, someone brings up the question of staying in school a while longer to get a master's or doctor's degree. How much demand is there for an advanced degree in engineering? Table 5 gives the percentage distribution of the engineering profession in 1946 according to educational level for the general fields of employment.

Since the matter of return on the investment in an advanced degree is always of interest, Table 6 is included to show the median salaries for the various educational levels at several levels of experience. There is little variation of salaries for the three college degrees during the first six years of experience, the greatest variation at aboute 20 years of experience and the variation disappears at about 30 years of experience. The highest salary levels in engineering are in the technical and non-technical administration-management field (higher years of experience) and the advanced degrees seem to be of little advantage in this type of work.

In college teaching and in engineer-

TABLE 2

Percentage Distribution of the Engineering Profession in 1946, by Major Industry Field and by General Field of Employment.

Industry Field	Total	Chem.	Civil	Elec.	Mech.-Indus.	Mining-Metal.	Other Engi.	Non-Engi.
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Agriculture and Forestry	0.5	0.5	1.2	0.0	0.1	0.1	1.1	1.5
Mining	6.1	1.6	0.8	0.6	1.0	55.1	13.4	6.6
Construction	18.4	2.9	63.9	4.6	4.1	0.4	12.2	5.6
Manufacturing	41.8	82.3	7.5	41.8	65.6	34.4	28.7	35.7
Transportation	2.2	0.1	4.1	1.6	1.9	0.1	3.3	3.1
Communication	4.2	0.2	0.1	13.8	1.3	0.4	3.3	3.2
Utilities	11.1	1.1	8.9	25.7	6.7	0.3	8.7	7.1
Personal services	9.4	6.8	7.3	6.8	12.8	5.3	17.0	22.4
Other fields	5.8	4.3	5.8	4.8	5.8	2.4	11.8	12.7
Unemployed	0.5	0.2	0.4	0.3	0.7	0.5	0.5	2.1

TABLE 3

Percentage Distribution of the Engineering Profession in 1946, by Class of Worker.

Class of Worker	Percentage
Total	100.0
Private engineering	76.3
Employe	67.1
Employer	6.0
Independent consultant	3.2
Public engineering	20.4
Federal Government	9.7
State Government	5.6
County Government	0.9
Municipal Government	3.4
Other public authority	0.8
Non-engineering	2.3
Student	0.4
Retired	0.3
Unemployed	0.3

ing research advanced degrees are highly desirable or in many cases essential. The trend seems to be towards a greater demand for advanced degrees in many other phases of engineering. When the supply of engineers exceeds the demand as is expected to occur by 1950 or 1951, advanced degrees will become of relatively greater importance in the process of selection.

3. *What factors should I consider in deciding upon a job?*

While salary is always an important and basic consideration, there are a number of other factors worth thinking about in choosing a job. They might be listed as follows:

A. On the job factors.
   1. Salary—present and future possibilities.
   2. Prestige and recognition given to engineers in the particular field of business.
   3. Opportunity for advancement—system for handling advancement.
   4. Do I like the type of work that I am to do?
   5. Character and congeniality of associates.
   6. Security and continuity of employment under variations in business conditions.
   7. Quality of engineering experience obtained.
   8. Possibility of contacts leading to a better position in other fields or with other employers.

B. Home factors.
   1. Availability of suitable housing.
   2. Character of community and its people.
   3. Amount of travel required on the job and the time at home.
   4. Amount of moving necessary.
   5. Accessibility of adequate schools for children.
   6. Recreational facilities in the area.

At this point you might be interested in some information about the range of salaries for engineering services. In Table 7 you will find a listing of the median salaries paid in 1946 to the various classes of engineering workers at several levels of experience. Salaries have generally increased about 10 to 20 per cent since 1946 with the largest gains in public engineering. Private engineering no longer offers the great advantage in pay, particularly in the early years of experience, that it did a few years ago. In order to give you an idea of the variation in salaries for several levels of experience, Table 8 is included.

Some of the factors listed above will be of interest to you and others will not. Check over the list, decide which elements are of concern to you and then fill in the corresponding information about the jobs which you are considering. By weighing the good and bad points of each job opportunity in the light of the relative importance of these factors to you, you are on the way to making a logical selection of the starting point in your engineering career.

TABLE 4

Percentage Distribution of the Engineering Profession in 1946, by Occupational Status.

Occupational Status	Percentage
Total	100.0
Administration-management, tech.	30.4
Design	14.9
Development	6.8
Research, applied	5.8
Construction, supervision	4.7
Teaching, college or university	4.4
Consulting, employe or private firm	4.2
Sales	4.1
Administration management, nontech.	3.6
Consulting, independent	3.6
Operation	2.4
Analysis and testing	2.2
Production	2.1
Any occupational status not specified	2.1
Maintenance	1.9
Drafting	1.1
Estimating	1.1
Inspection	0.9
Editing and writing	0.7
Installation	0.6
Research in basic science	0.6
Patents	0.3
Safety engineering	0.3
Student	0.3
Unemployed	0.3
Personnel-labor problems	0.2
Teaching, other	0.2
Retired	0.2

How Can I Make the Most Out of My Job?

While the selection of the right job for you requires careful consideration, it is more important that you make the most of whatever job you take. You may get nowhere on the very best job that you could have chosen and you may be very successful in a much poorer job opportunity, depending upon your own capabilities and application to the work.

Since most of you will be employes, at least for a time, a few suggestions from the employer's point of view may help you to make a better impression and to do a better job.

A. Give your employer full value for his money.
   1. Be at work on time.
   2. Don't be a clock watcher or afraid of a little extra time. Engineering is brain work, and brain work is note very well regulated by the clock.

B. Show interest and enthusiasm for your work.
   1. Seize every chance to learn more about the business.
   2. Continue to study and improve yourself—your knowledge at graduation is only a small fraction of what you will learn in the next 10 years unless you are content to stagnate and sit in one place.
   3. Don't be afraid to tackle a new job. Get as much varied experience as you can. Advancement depends upon your breadth of experience,

TABLE 6

Median Monthly Salaries for the Engineering Profession in 1946, by Basic Educational Levels and by Experience Level.

Basic Educational Level	Exp. Level in Years 6	20-24	30-34
Doctors	$400	$534	$575
Masters	367	501	580
Bachelors	337	489	568
Incomplete college	316	421	507
No college	340	411	472

TABLE 7

Median Monthly Salaries for the Engineering Profession in 1946, by Classes of Engineering Workers and by Experience Level.

Classes of Engineering Workers	Exp. Level in Yrs. Under 1	9-11	25-29
Private engineering employes			
Chemical	$256	$443	$765
Civil	243	371	476
Electrical	237	366	535
Mechanical Industrial	225	405	567
Mining-Metallurgical	236	431	623
Other engineering	224	399	595
Non-engineering	215	417	659
Private engineering Employers	235	484	672
Independent consultants		415	513
Public engineering employes			
Federal Government employes			
Civil engineering	225	368	486
All other engineering	230	403	495
Non-Federal Government employes			
Civil engineering	234	314	371
All other engineering	230	343	432

particularly for the better jobs which are administrative in nature.

C. Organize your work. Plan things ahead so that you know where you are going. Be neat and orderly. Practice lettering and drafting, the tools with which the engineer expresses his ideas.

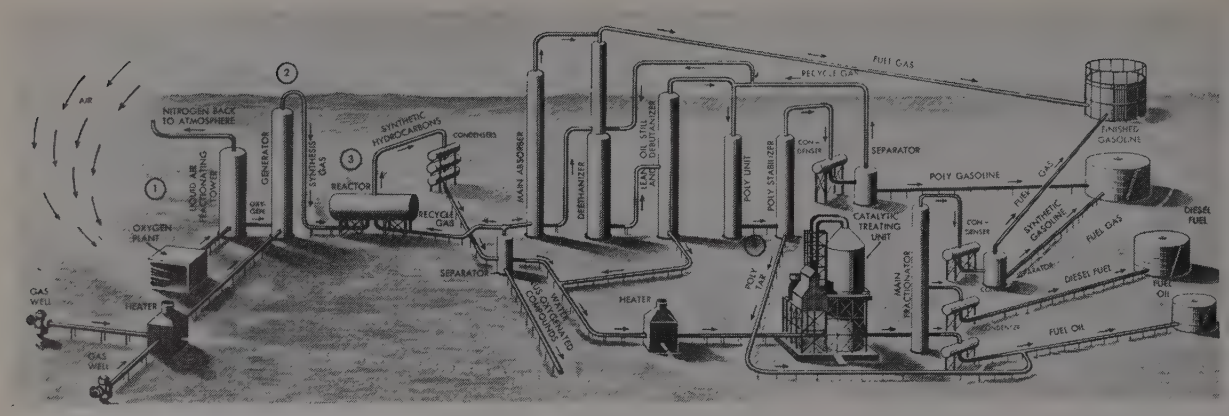
D. Practice speaking and writing *clearly concisely* and *correctely*. This is the means by which you sell yourself to your employer. How much you

(Continued on page 22)

TABLE 5

Percentage Distribution of the Engineering Profession in 1946. by Educational Level and by Genetral Field of Employment.

Basic Educational Level	Total	Chem.	Civil	Elec.	Mech.-Indus.	Mining-Metal.	Other Engi.	Non-Engi.
All Levels	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Doctors	3.7	12.7	1.8	2.4	2.0	7.1	4.5	2.5
Masters	15.4	24.0	13.7	13.4	14.9	19.3	14.1	15.0
Bachelors	63.8	57.2	63.7	66.2	67.3	57.4	61.2	60.5
Incomplete college	13.0	4.7	15.9	13.6	11.7	12.5	15.7	16.0
No college	4.1	1.4	4.9	4.4	4.1	3.7	4.5	6.0



A simplified illustration of the Hydrocol process for production of synthetic fuels in shown above. This process is to be put in operation by Carthage Hydrocol, Inc., at Brownsville, Texas, near the San Salvador natural gas fields. (Photo courtesy of "Texaco Star.")

FROM GAS TO GASOLINE

By Ray Hauser, Chem.E. '50

There has been considerable interest lately in the economic and industrial feasibility of synthesizing liquid fuels and lubricants from carbon monoxide and hydrogen. The need for such a process to augment our diminishing crude petroleum reserves has led to hurried, but significant, advances. Both coal and natural gas are being investigated as raw materials. It is estimated that natural gas will last only a few decades, but coal is expected to last for centuries—especially if lignite can be used successfully. Conversion of coal to gasoline has not yet become economically practical, but conversion of natural gas to hydrocarbons is already of great significance.

The Fischer-Tropsch process for synthesis of liquid fuels has been varied so many times, and so much, that the aggregate systems are now being called the "synthine" process. Carbon monoxide and hydrogen in the right proportions react under the proper conditions to produce a mixture of aliphatic alcohols, aldehydes, ketones, acids, and esters called "synthol." Although the yield of hydrocarbons is only one per cent, heating of synthol for an hour at 840° F. gives a mixture of hydrocarbons and oxygenated compounds. Separation, refining, and polymerization of the hydrocarbons produces gasoline and oils. The alcohols, aldehydes, and ketones are by-product chemicals of considerable value.

Synthesis gas is the basic material from which petroleum products are made. It is mainly a mixture of CO and H_2, the exact composition depending upon the process to be used and the products desired from synthesis. The normal-pressure synthesis method uses a H_2:CO ratio of 2:1, and the more prominent medium-pressure synthesis uses a ratio of 1.4:1.

RAY HAUSER

A prospective chemical engineer of 1950 is blond-haired, blue-eyed Ray Hauser.

A native of Litchfield, Illinois, Ray was born on April 16, 1927. A loyal member of the Honorable Order of BMOC's here on the campus, his activities include an assistant editorship of TECHNOGRAPH, membership in A.I.Ch.E., and Engineering Council.

Outside of the slipstick realm he is active in McKinley Foundation as a member of the choir and chairman of the recreational committee. Like many others, Ray came to college after he left the Navy in 1946.

Synthesis gas may be made from coal or from methane, depending upon the availability of the raw material and the cost of production. Production from coal may be done by the "Winkler" generator, water gas process, or by underground burning. Methane may be obtained from coke oven gas or natural gas.

Are you worried about a future gasoline shortage? Synthetic gasoline prepared from hydrogen and carbon monoxide may soon be at the gas stations to help prevent this condition. This article presents the Fischer-Tropsch, or Synthine process of liquid fuels.

The "Winkler" system uses cheap lignite, a very low-grade brown coal that is found extensively in this country. A high-velocity blast of hot oxygen and steam passes through a bed of lignite. A temperature of 2500° F. is attained, and the entire mass—except moisture and ash—is converted to CO and H_2. Impurities are usually present, especially sulfur products. The necessary oxygen is usually obtained by the Linde-Frankl process, involving fractionation of liquid air. The cost of lignite is very low, but the expense of producing oxygen is considerable.

Where practical, water gas prepared from coke and having the composition, CO—40%, H_2—50%, CO_2—5%, and N_2 and CH_4—5%, may be used. However, the H_2:CO ratio is too low for hydrocarbon synthesis, and the proper ratio is attained by conversion of a portion of the CO to CO_2 by high-temperature oxidation over FeO. In this conversion, steam and water gas are passed over the iron oxide catalyst at 840-925° F. The per cent bypassing the convertor is regulated according to the exact composition of the original gas and the required H_2:CO ratio of the synthesis gas. The carbon dioxide produced by the conversion is passed through the Fischer-Tropsch reactors, its effect being only that of a diluent.

Underground gasification of coal is

(Continued on page 24)

The Engineering Honoraries and Societies

By Bill Soderstrum, Cer.E. '52

SIGMA TAU

Radar! That awesome subject was the main theme of the address titled "Nothing Is Impossible" which was delivered by Dean L. N. Ridenour, dean of the Graduate College, to Sigma Tau, all-engineering honorary fraternity. Dean Ridenour addressed the group at its initiation banquet held on January 12, 1949, at the Town Club.

Members initiated to the fraternity at this time are as follows: H. O. Barton, L. F. Brown, R. Brown, D. Burgener, R. A. Campbell, D. T. Carter, W. H. Christoffers, R. D. Collins, H. G. Cooper, J. W. Crawford, P. Dasher, F. S. Eby, R. D. Eilers, B. W. Everitt, W. J. Evers, J. F. Farris, J. J. Fishman, J. Gordon, J. R. Harlan, M. Henderson, J. R. Howard, R. L. Hyde, R. N. Irgens, W. Jarvis, J. Johnson, G. Keele, H. W. Knoebel.

S. W. Kulcinski, L. G. Ladof, R. T. Loewe, A. London, W. R. Loomis, G. Massie, C. A. McGovney, P. Mooney, T. G. Morrison, H. M. Passman, R. L. Parr, C. M. Peterson, E. Petkus, D. P. Protzman, R. M. Robinson, W. A. Schaaf, R. E. Schilson, E. W. Schwarz, H. B. Scott, S. C. Sommer, J. Stephens, N. E. Wandke, P. Wargo, H. Ward, H. C. Watton, D. Weaver, M. J. Weberling, I. Weissman, R. E. Wilson, D. W. Wright, and L. K. Yoskowitz.

S.B.A.C.S.

A colored film on the making of steel opened the pre-Christmas meeting of the Student Branch of the American Ceramic Society held on December 16, 1948.

After the films, the new constitution and by-laws of the organization were discussed and ratified. After the business meeting, refreshments were served and a general "bull session" was in order.

Officers for this semester, who were nominated at the December 16 meeting and elected at the January 10 meeting, are president, Norman Russell; vice president, Bob Bender; secretary, John Cox; historian, Lucas Pfeiffenberger; treasurer, Al Siska; and Executive Council representative, Howard Rapp.

Mr. Ralph Hanna, ceramic engineer of the Square D company of Peru, Ind., was the speaker at the January 10 meeting. He addressed the group on the "Background of Ceramics and Ceramics in Industry."

As a grand finale to the semester activities, the society held a record dance on January 15, 1949, in 314 Illini Union.

M.E. NEWS

Two M.E. societies and one M.E. honorary fraternity banded together to sponsor a Senior-Faculty banquet. Pi Tau Sigma, honorary fraternity, S.A.E. and A.S.M.E. gave the banquet in the Illini Union ballroom on January 6 in an attempt to revive the prewar annual event.

Dr. Henning Larsen, dean of the College of Liberal Arts, was the guest speaker. Approximately 170 members attended.

ETA KAPPA NU

"The Two Most Seductive Women in History." This (believe it or not), was the topic that Dr. R. G. Bone, director of the Division of Special Services for War Veterans, chose for his speech at the semi-annual initiation banquet of Eta Kappa Nu. In his address, Dr. Bone discussed a few of the more illuminating adventures of Cleopatra and La Maquise d'Aubrion.

This banquet, which was held December 15, 1948, at Hotel Tilden Hall, was also the scene for the election of officers. Officers elected at this time included president W. A. Schaaf; vice president, K. R. Brunn; corresponding secretary, J. R. Stone; recording secretary, E. A. Kitsch; treasurer, J. Schrivner; and bridge correspondent, G. B. Foster.

Seventy undergraduate and eight graduate students were initiated into the electrical engineering honorary fraeternity at this banquet.

The last noon-time luncheon of last semester was held on Monday, January 10, 1949, at the University Club. Dr. H. R. Bowen, dean of the College of Commerce and Business Administration, was the guest speaker. Dean Bowen spoke on "The Causes of Wars," in which he briefly discussed historical causes of war and their possible effect in the future.

CHI EPSILON

Do you ever wonder what a civil engineer does? And is a civil engineer always civil? Prof. J. J. Doland didn't answer these questions but he did say "What a Civil Engineer Might Do." This was the subject of his talk at the Chi Epsilon initiation January 5, in which he brought forth some good advice for the members.

Thirty-one initiates received a warm welcome into the organization and a banquet meal consisting of swiss steak and all the trimmings. George Roberts, president of the local chapter, served as toastmaster and Gerald Engelhart welcomed the new members. George Wear responded to the latter in behalf of the initiate class.

Club Commons in the Illini Union was the scene of a very enjoyable party and dance held Saturday, January 15, for the members and their guests. Tricks of magic during the intermission were especially entertaining and contributed to the good time had by all.

I.E.S.

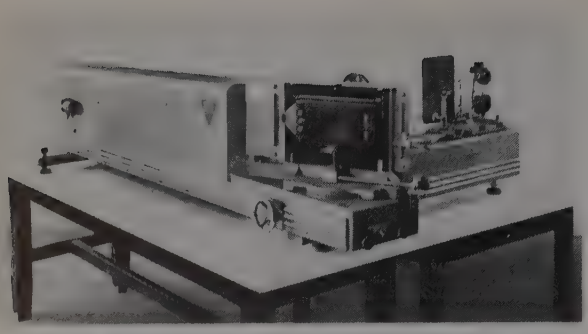
Dr. Ward Harrison, international authority on lighting, was the speaker at the January 13, 1949, meeting of I.E.S. Dr. Harrison, former director of engineering for the General Electric Lamp department at Nila Park, spoke on glare factors that are important in lighting design. At present he is doing research work toward eliminating glare in lighting installations.

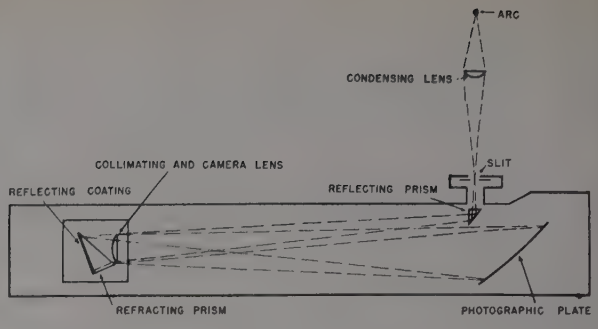
A new secretary-treasurer, Robert Vandenboom, was elected at this meeting. The next meeting is tentatively scheduled for February 16.

A.F.S.

"We're in!" The University of Illinois Student Branch of American Foundrymen Society was accepted into the Engineering council last December. Latest arrival on north campus, the American Foundrymen Society was officially installed on October 22. James L. Leach, assistant professor in the M.E. department, is the faculty adviser for the group, whose aim is to enlighten students in the possibilities of foundry work.

(Continued on page 31)





The Bausch and Lomb spectroscope of the large Littrow-type is pictured in Figure 1 (left) and outlined in Figure 2 (right). (Photos courtesy of Bausch and Lomb.)

Undercover at... GALESBURG

The Magic of the Spectroscope

The science of spectroscopy is defined as the science of the phenomena observed by the spectroscope. Such phenomena is the process of breaking a light beam up into its constituent wave lengths. The discovery and development of this process or any process of this type dealing with light has been a most recent one. It was for Sir Isaac Newton, early in the 18th century, to make the initial discovery. In his experiment, he allowed sunlight to pass through a small round hole, a glass prism, and then let it fall on a screen. The view on the screen was a series of colored images of the hole which he named the spectrum. He developed his idea to the extent that he came very near to the production of a modern spectroscope. Newton later recognized that this series of colors appeared in the same order with each additional experiment. This, however, was the limit of Newton's discovery and his prestige at this time was such that he sent everyone off on the wrong track when he refuted the idea that emitted light was characteristic of the atom or molecule which produced it.

At the turn of the 19th century many discoveries led to the modern concept of spectroscopy. Among these were the discovery of the infra-red spectrum, the ultra-violet spectrum, wave length determinations, and the finding of the lines in the sunlight spectrum and the subsequent lettering of these lines with the surprisingly accurate wave length determination which resulted. The final step in making spectroscopy the true science it is today was the realization that each atom or molecule has its own characteristic spectrum. This conclusion was gradually brought about by experiments with light sources of single certain types of light waves.

A process by which industry has made use of this great discovery is in the analysis of samples of an unknown material. This process is so developed today that not only can we get a qualitative analysis but also a quantitative analysis. The process is initiated with the arc (see Fig. 2.) The sample is introduced here into a source of temperature which is high enough to volatize it and convert it into a luminous vapor. This can be accomplished in many ways with the sample in a solid or liquid form and with a high temperature source, which can be anything from the Bunsen burner to a high tension spark. The light given off, characteristic of all the elements in the original sample, passes through the condensing lens and then to the slit. The width of the slit has a great deal of effect on the resolving power, which is the ability of the instrument to separate the light of different wave lengths. The slit must be kept free of dust particles because the end result is a series of images of the slit and the dust particle would show up on the photographic plate. The light then passes through the instrument to the refracting prism. This is the heart of the apparatus, in as much as here is where the work of separating the light into its own wave length is done. (Instead of a prism, many instruments are now made with a defraction grating which is a piece of glass with as many as 20,000 lines to the inch etched upon it.) The shorter the wave length the more the rays are bent and every type of light, representative of its element, is therefore divided and recorded on the photographic plate.

From this brief description one can see how a qualitative measurement can be made. However, the quantitative measurement is made by determinations

(Continued on page 18)

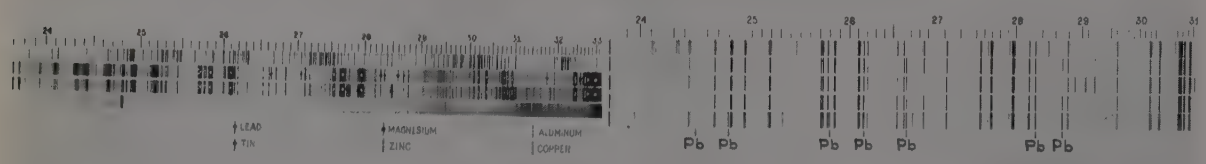
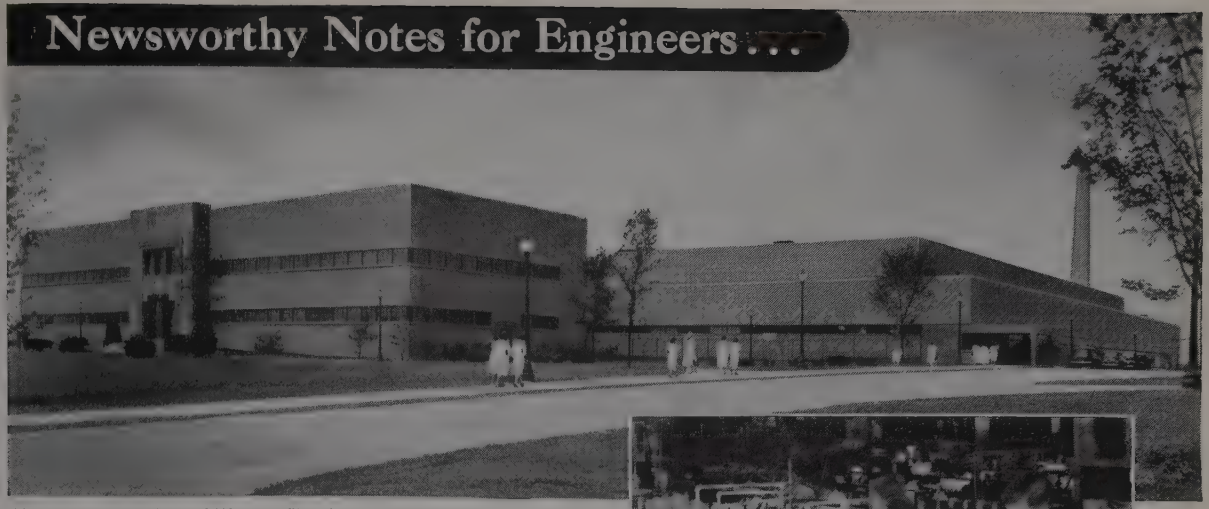


Figure 3 (left): In these spectra of two die casting alloys containing 93 per cent zinc, four per cent aluminum, and three per cent copper the second spectrum from the top was an alloy that failed. Figure 4: Lead in a sample quantitatively determined by these spectra. (Photos courtesy of Bausch and Lomb.)



New electronics plant of Western Electric at Allentown, Pa.

Complex job for Engineers

This new "controlled atmosphere" plant, which produces electronic equipment for your telephone service, posed many interesting problems for engineers at Western Electric—manufacturing unit of the Bell System.

For example, a speck of dust or a trace of perspiration may seriously impair the efficiency of vacuum tubes, thermistors, varistors and mercury switches manufactured here. To meet these problems, the new plant is completely air conditioned, with strict control of temperature and humidity—sealed except for doors, and slightly pressurized to keep out dust.

Over 40 miles of pipes deliver 13 needed services to working locations. These are hydrogen, oxygen, nitrogen, city gas, city water, deionized water, soft water (cold, hot, cooling) high pressure air, low pressure air, process steam and condensate return.

Assembling miniature electron tubes—typical of the high precision work at Allentown—calls for finest lighting. It is provided by a scientifically designed system containing over 13,000 fluorescent tubes.

Other "musts" in planning included proper illumination for high precision work—a complex network of piping to deliver 13 needed services—a gas generating plant—a highly efficient chemical waste disposal system.

But beyond the problems solved in helping to design the plant itself, Western Electric engineers met many a challenge in working out highly efficient manufacturing layouts, machine design and production techniques to assure a steady flow of highest quality electronic devices of many types.

This new Western Electric Plant at Allentown is a measure of the ingenuity and thoroughness of Western Electric engineers—electrical, mechanical, industrial, civil, structural, chemical, metallurgical—who provide equipment that helps make Bell telephone service the best on earth.

Western Electric

A UNIT OF THE BELL SYSTEM SINCE 1882

GALESBURG . . .

(Continued from page 16)

of the densities of the lines. (Fig. 4). The more dense the lines the greater the quantity of the element present in the sample. The spectroscope is a most sensitive instrument and in cases where the element may be present in too small an amount to be noted by chemical analysis, the spectroscope will discover it.

To aid in the identification of elements, most instruments have a provision for imprinting a scale of approximate wave lengths on the plates (note the numbers on the tops of Figs. 3 and 4.) This system is of its greatest value when the same spectrum is to be photographed repeatedly. If the plates were not numbered a new set would be required for each test. A more accurate identification of the lines is made either by comparing them with the spectra of known elements, photographed adjacent to the spectrum to be studied, or by measurement of the wave length of the line (see Fig. 3, the top and bottom spectrum are comparison spectrum). The iron spectrum is usually the one photographed as an identification, since it has many lines well distributed throughout the spectrum and their wave lengths are known to a high degree of accuracy. With experience, one can usually classify an unknown line by comparing its position to that of certain groupings of the known spectrum. Because of the very accurate results of analysis obtained from the spectroscope, many manufacturers are turning to it as a means to analyze materials before they are unloaded.

Certainly no article on spectroscopy can be written without mentioning its use in the field of astronomy. One of the more recent determinations is that water, in a solid state only, exists on the planet Mars, was made with a new infra-red spectrometer by Mr. Gerard Peter Kuiper at MacDonald Observatory in Texas. The ballistic research laboratory of Aberdeen proving ground, Maryland, is studying the jet of the V-2 rocket in flight by these methods. It seems entirely possible that by the time the space-ship era arrives, details of the life or lack of life on the outlying planet, to which a ship of this sort could go, will be known.

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HOUSE OF MAGIC

Music that is transmitted by a beam of light, spinning gears that seem to be stopped, and the many other oddities of science that are shown in the General Electric "House of Magic" show lead a person to believe in the old adage that truth is indeed stranger than fiction.

In 1930 the late radio commentator Floyd Gibbons visited the General Electric research laboratory in Schenectady, New York, and exclaimed that the laboratory was truly a house of magic. In 1933, for the Chicago world's fair, a show was made up using interesting parts of this laboratory which were believed to be of interest to the average person and thus the show which we now call "House of Magic" was born. This show now has played at all of the major world's fairs and in all the states of the Union plus many of the provinces of Canada.

Mr. Hoverman of General Electric lights a flourescent tube without the aid of electrical connections.

The G. E. laboratories, noted primarily for their research in the fields of electronics, also delve into the research of modern chemistry. An example of one of the recent discoveries of the research chemists has been the perfecting of the important substances called "the silicones." One of the most interesting is a by-product referred to as "bouncing putty." This material, if slowly formed into any shape, will retain that shape, but if an attempt is made to change this shape suddenly, the putty has a strong tendency to return to its original form. This property makes it especially practical for use as golf ball centers and other similar uses.

An aid to modern medicine has been made in the form of the inductotherm. This apparatus produces high frequency waves which will induce artificial fever in the human body. Most doctors believe this will aid the natural heat of the body to combat certain disease bacteria. With the induced current from the coil of the inductotherm, Mr. Hoverman, the G. E. representative, was able to light gas-filled and common light bulbs by holding them in his hands.

In the "House of Magic" demonstration of stroboscopic light, a gear which was spinning at speeds above 1,000 r.p.m. appeared as though it were standing still. This stroboscopic lamp is capable of delivering a flash of light which has a duration of one five-millionth of a second or less. By carefully timing this ray of light so that the flash always takes place when the wheel is in the position occupied during the preceding flash, the eye sees the wheel as if it were standing still. Using two different colored lamps and timing one slower than the other in relation to the revolutions of the wheel, the illusion of two oppositely turning gears was formed. The stroboscopic light is used in industry today in the study of rapidly spinning gears, turbines, and propellers under conditions which are actually experienced in their varied uses.

Another use of the stroboscopic lamp is in the taking of pictures of ultra-high speed objects. When used in this manner, the lamp is connected to a photo-electric cell which trips the lamp and the camera shutter at the same instant. An example of this would be in the study of the fracture of a high speed turbine. In this study a beam of infra-red light is directed on the spinning turbine and as the turbine fails, an electric eye is uncovered which simultaneously activates the camera shutter and the stroboscopic lamp. This results in a picture of the object at the exact instant of failure. This procedure is also used in the photography of projectiles while in flight.

A very popular portion of the show is the small train which seems to obey the spoken commands of the demonstrator. This model will back up, go forward or stop when the operator speaks into a microphone. Although the train seems to obey the spoken command it is the number of syllables of the command which operate the sensitive selector switches. This was shown when a meaningless series of sounds caused the train to operate in the desired manner as long as the series contained the proper number of syllables.

One of the highlights of Mr. Hoverman's demonstrations was the transmission of sound on a beam of light. While the transmission of sound by radio waves has become quite common to the world, the science of using a light wave for this purpose is still in the experimental stage. To demonstrate this phenomenon, an ordinary phonograph turntable was used

(Continued on page 36)

Mercury, "messenger of the gods," was slow compared with Ultrafax—which moves at the speed of light.

This messenger
delivers a million words a minute

Recently, at the Library of Congress, a distinguished audience saw documents flashed across Washington by a new means of communication . . . and reproduced before them in *facsimile.*

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Material to be sent is placed before an RCA "flying spot" scanner, and transmitted by ultra-high frequency radio signals. Miles away the pictures appear on a picture tube and are photographed. Negatives are ready for printing or projection in 40 seconds.

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In This Corner...

NAVY PIER

Engineering Societies

Bob King '51

A.S.C.E.

There were about 120 members and guests at the regular monthly meeting held by the A.S.C.E. on January 6. Besides the regular business, those present heard a discussion of "Pumpcrete," by Mr. Roy Hawkins of Chain Belt, Milwaukee.

Arrangements were made for meetings to be held during the spring semester, with the first one on February 22, at which time the survey camp for 1949 will be discussed.

I.A.S.

At its last meeting the I.A.S. discussed the constitution of the newly formed Engineering Council. The principle sections of the constitution were read by Jack Jensen, and a talk on the purpose of the council was given by Mr. Zanotti, the faculty sponsor. The constitution was ratified, with minor changes, and is subject to further ratification by the Engineering Council.

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Robert Groemling ..... *Photography*

PHI ETA SIGMA

The freshman honorary society, Phi Eta Sigma, here at the Pier, has a total membership of 57. The engineers have something to be proud of in their representation of 22 members. Two of the officers are engineers; namely, John Fijolek, president, and Henry Aoyama, treasurer. The following is a list of, if you'll pardon the expression, "brains" who were fortunate enough to keep their averages above 4.50, thus making them eligible for membership.

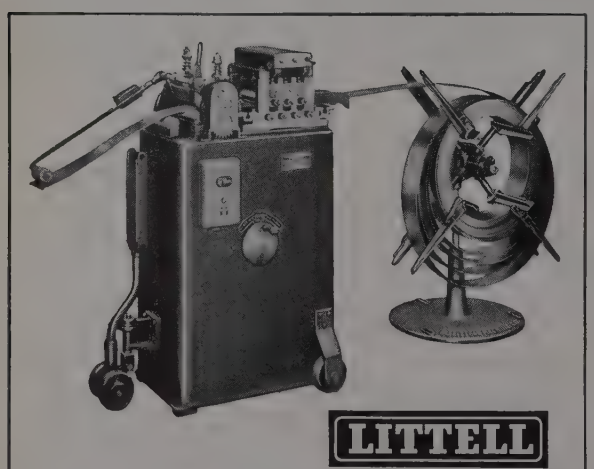
Marion Baty, Gordon Brenker, Bruce Capek, James Cleary, John Fijolek, Charles Furtak, Bill Gillespie, Tony Grieco, Lloyd Gross, Henry Aoyama, Norman Inoue, Henry Lahr, Alexander Magnus, Ed Mattbei, Jim Nakanishi, Gordon Nelson, Harry Quinn, Gilbert Riske, Bill Roseberry, Bob Seavey, Vic Swenson, and Charles Wheeler. Congratulations, boys!

A Scot who was a poor sailor was crossing the Channel. He went to the captain and asked him what to do to prevent seasickness.

"Have you got a sixpence?" asked the captain.

"Aye," replied Sandy.

"Well, hold it between your teeth during the trip."



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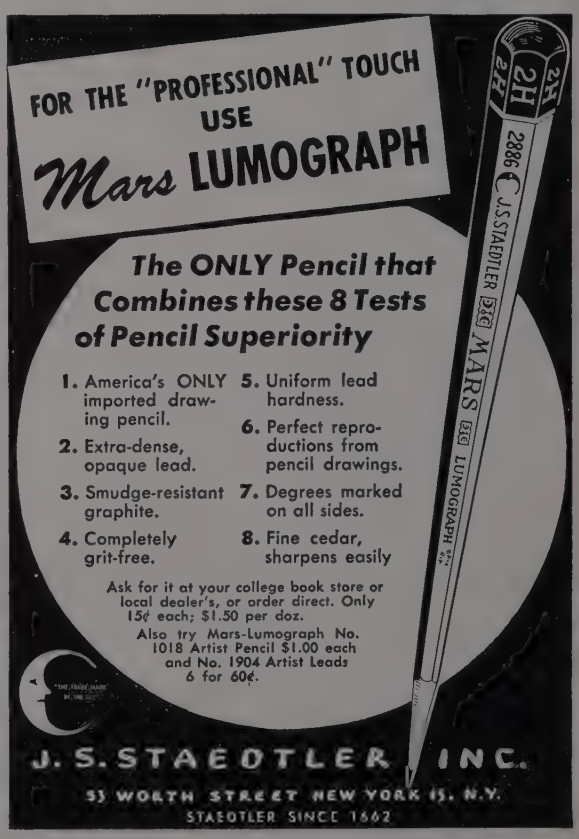
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YOUR CAREER . . .

(Continued from page 13)

know is of little importance if you can't convey that information to others.

TABLE 8

Variation in Monthly Salaries for the Engineering Profession in 1946, by Experience Level.

Range	Exp. Level in Yrs. Under 1	9-11	20-24
Lower 10 per cent	$181	$287	$310
Lower 25 per cent	206	333	409
Median	231	395	481
Upper 25 per cent	259	470	623
Upper 10 per cent	298	561	889

E. Consider other people. Learn how to get along with them. Know your boss and how he wants things done.

F. Develop initiative. See things to be done without being told and find methods of improving the things that you are doing. Don't be afraid to make suggestions and to lead the way.

G. Finally: enjoy your work or change your job. Much of your lifetime will be spent at work.

All statistical data in this article is reproduced by permission of Engineers Joint Council from the Report "The Engineering Profession in Transition."

Wife: "Dear, I saw the sweetest little hat downtown today."

Husband: "Put it on; let's see how you look in it."

* * *

The man with a wonderful vocabulary is one who can describe a shapely girl without using his hands.

* * *

"Do you drink?"

"No."

"Then hold this quart while I tie my shoe."

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Excellently prepared in sanitary surroundings

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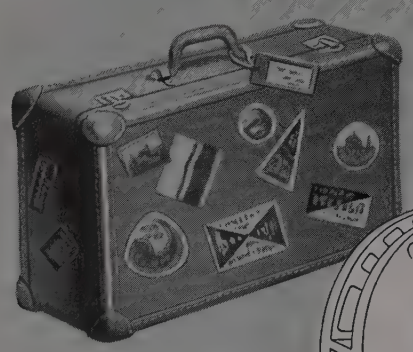
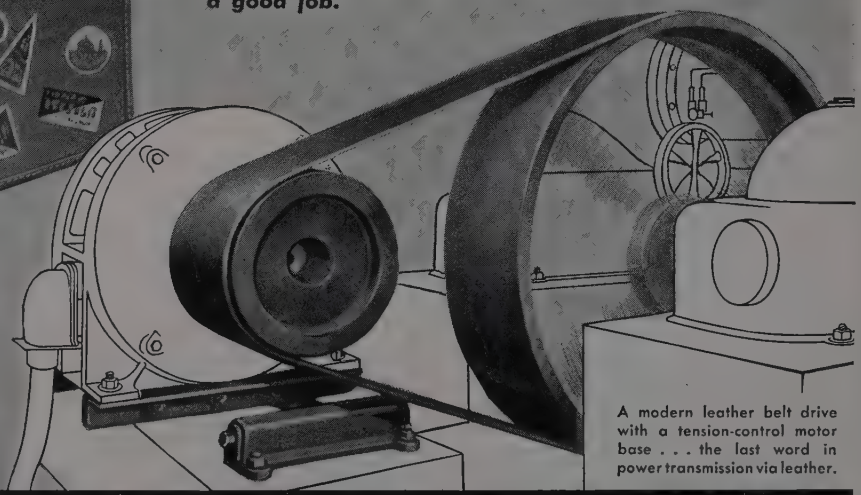
Leather has "travel endurance"

When you see a piece of "globe-trotting" luggage, you're looking at leather that's been around. It has taken a long-term beating but is still doing a good job.



Modern leather belting used for power transmission has that same inherent wear-resistance. That's the reason why it is marking up records for long service traveling around the pulleys of modern industry.



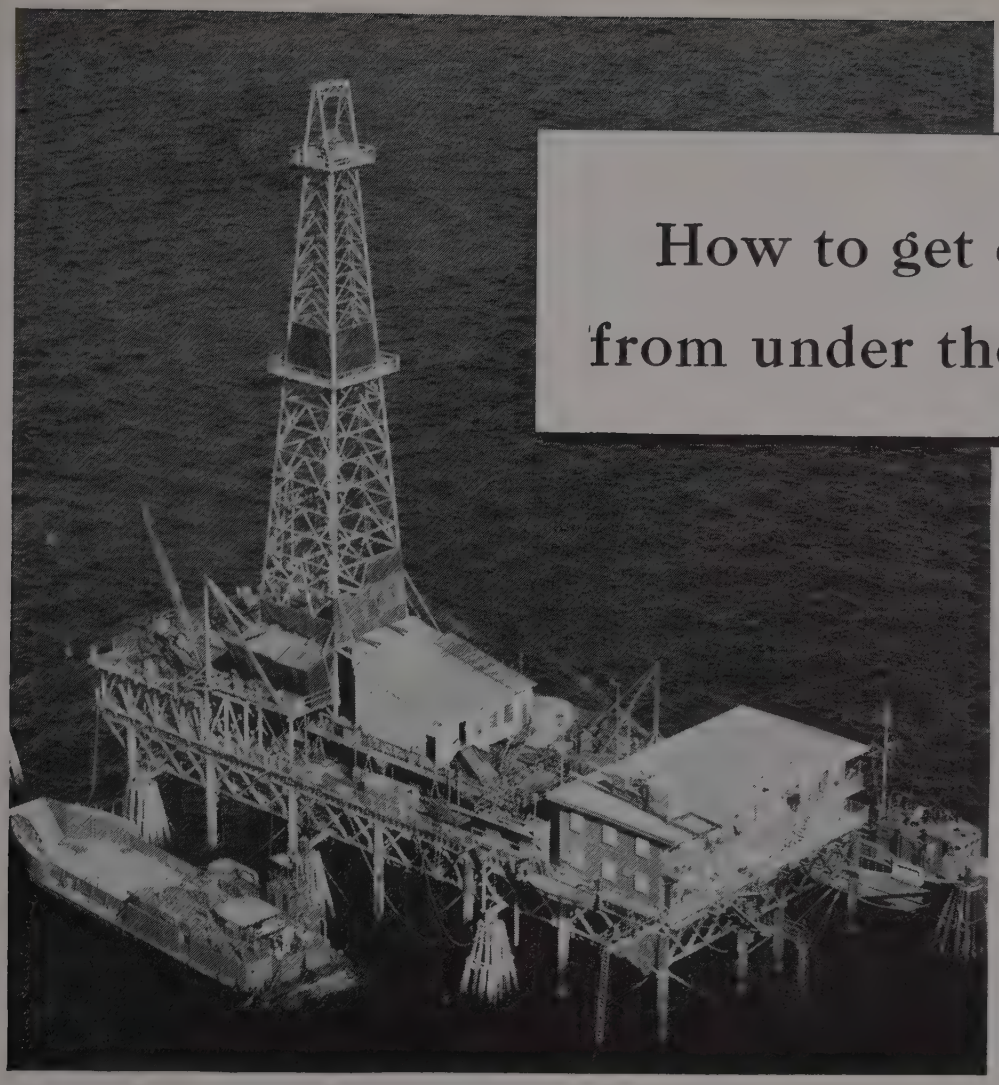
A modern leather belt drive with a tension-control motor base . . . the last word in power transmission via leather.

AL-31

American LEATHER BELTING *Association*

Headquarters for Authentic Power Transmission Data

41 PARK ROW, NEW YORK 7, NEW YORK



How to get oil from under the sea

OUT of sight of land, miles offshore in the Gulf of Mexico, oil is now being brought from under the bottom of the sea.

Through its subsidiary, the Stanolind Oil and Gas Company, Standard Oil undertook to develop this new source of oil to help fill the growing need of Americans for petroleum products of all kinds. Offshore drilling presented our technical men with brand-new problems. These were solved so successfully that oil hitherto unavailable is beginning to flow to refineries, and products made from that oil are helping meet the public's huge demand.

This is important news to an oil-hungry nation, now and for the future. It is also a tribute to the ingenuity and skill of the Stanolind Oil and Gas Company men who engineered the project. There are places in Standard Oil for other men who, in the research and operating departments, can help find new ways to provide more and better petroleum products.

Standard Oil Company

(INDIANA)

STANDARD

STANDARD SERVICE

GASOLINE . . .

(Continued from page 14)

the project of extended interest and research. The cost of "mining" is very low, and there is no transportation expense. Especially adaptable to inclined seams, the stream method of gasification is the simplest of several processes. Two shafts, a convenient distance apart, are drilled into a seam and a galley is driven through the coal connecting the shafts. A fire is started at the bottom of the deeper shaft, and steam and air are alternately blasted in from above. The coal surrounding the fire is burned to CO_2. In passing along the galley, however, this is reduced in the presence of steam to CO and H_2. These are taken off at the top of the outlet shaft. Ash is formed as the burning progresses along the galley and falls to the lower part of the seam where the coal is already burned out. Thus, the ash doesn't obstruct the access of inlet gases to the coal surface.

The coke-oven gas (methane) conversion is accomplished in two steel towers, lined with refractory brick, and filled with refractory checker brick. As the reaction is endothermic, the temperature must be maintained at 2550° F. The two towers alternate in function, one converting the gas while the other is being heated. Water for the reaction is supplied by passing the gas countercurrent through a water-saturation tower at 158° F. The reaction in the conversion units is:

$$CH_4 + H_2O \rightarrow 3H_2 + CO.$$

The heat required for the high-temperature reaction is a decided disadvantage of this process.

Natural gas is to be used in the methane-oxygen process at a plant of Carthage Hydrocol, Inc., now being constructed at Brownsville, Texas. Partial oxidation of the methane to synthesis gas follows the overall reaction,

$$CH_4 + \tfrac{1}{2}O_2 \rightarrow CO + 2H_2.$$

This reaction gives off thirty thousand calories per gram mole of CH_4 burned. Use of the heat from synthesis gas production to drive turbo-compressors for the plant is expected to result in a net oxygen cost of five cents per thousand cubic feet. Proof of the economic feasibility of this process is the estimated daily yield of 6,000 barrels of gasoline at a cost of five and one-quarter cents per gallon (compared with petroleum-base gasoline at seven and one-quarter cents per gallon).

Synthesis gases from all the foregoing processes contain some sulfur impurities, principally in the form of H_2S and organic sulfides and mercaptans. As presence of more than ten parts of sulfur in a million parts of gas poisons the catalysts used in the synthesis process, its removal must be practically complete. The H_2S is removed by passage through a bed of moist iron oxide, forming FeS. The organic sulfur is then removed by passing through a 30 per cent Na_2CO_3, 70 per cent FeO mixture at 356-536° F. About 0.25 per cent oxygen is added at the inlet to oxidize the organic sulfur to sulfates, which deposit as sodium sulfate.

Catalytic Synthesis Process

Choice of products and process conditions, as well as production costs, determine what catalyst should be used in synthesis of liquid fuels. A high yield of saturated hydrocarbons is obtained by using nickel-base catalysts to hydrogenate synthesis gas having a H_2:CO ratio of 2:1. The predominant reaction is:

$$nCO + (2n+1)H_2 \rightarrow C_nH_{2n+2} + nH_2O$$

A cobalt-base catalyst used with synthesis gas of the same composition gives the same type of reaction, with about 25 per cent of the reactants forming olefins by the following reaction:

$$nCO + 2nH_2 \rightarrow C_nH_{2n} + nH_2O$$

Iron catalysts at higher temperature and pressure causes the formation of

(Continued on page 26)

AN OKONITE "TWIST" ON CABLE TESTING

Okonite research includes subjecting short lengths of electrical cable to torsion tests (pictured above), twisting them through a spiral arc of 180° under a heavy load.

Bending tests, impact tests, tests of wear-resistance by abrasion — these are a few of the mechanical tests which, along with electrical, chemical and weather-exposure tests, complete an integrated program of performance checks. From its results comes information which Okonite engineers translate again and again into wire and cable improvements that mark major advances in the field. The Okonite Company, Passaic, New Jersey.

5171

OKONITE SINCE 1878
insulated wires and cables

Temperature Ranges Required for Pressure Vessels at BLACK, SIVALLS & BRYSON, Inc. Demonstrate Controllability of *GAS*

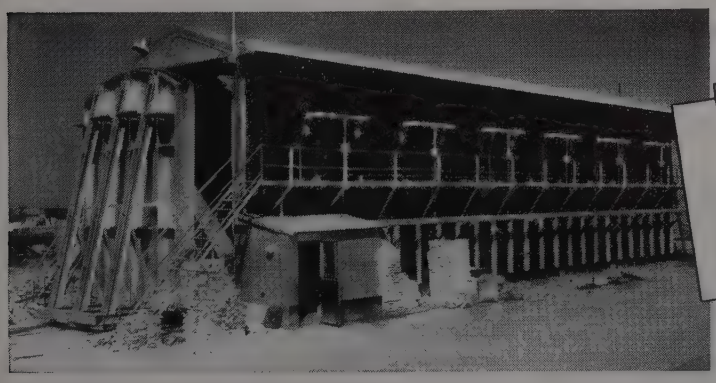
Safety codes govern many of the manufacturing and testing methods for pressure vessels. One of the most important processes, stress relieving, requires precise control of temperatures throughout the cycle—just the type of temperature control to be found in thousands of industrial applications of GAS for heat treating.

Specialists in the manufacture of pressure vessels depend on GAS for heat processing of all types. The pioneering firm of Black, Sivalls and Bryson, Inc., Kansas City, uses GAS in the manufacture of tanks, valves, pressure vessels and safety heads. President A. J. Smith says,

"Throughout the past 25 years we have depended on GAS to provide the exacting temperatures for our work. In many of our plants we have developed special GAS equipment; our large stress-relieving furnace at Oklahoma City is a typical example."

In this large furnace the GAS control system is arranged to provide temperatures up to 1200° F. for any time-cycle required. Automatic regulators and recording pyrometers assure maximum fuel efficiency while the flexibility of GAS is an important factor in maintaining production schedules on vital equipment.

Stress-relieving is just one of the applications of GAS for heat processing. You'll find hundreds of other uses for the productive flames of GAS—they're worth investigating.



MORE AND MORE...

THE TREND IS TO GAS

FOR ALL INDUSTRIAL HEATING

One of the largest stress-relieving ovens in the United States, this installation at Oklahoma City is 77' long, 12' wide, 18' high—Gas-fired and equipped with recording pyrometers.

AMERICAN GAS ASSOCIATION

420 LEXINGTON AVENUE NEW YORK 17, N. Y.

GASOLINE . . .

(Continued from page 24)

about 75 per cent olefins in the resultant product:

$$2nCO + nH_2 \rightarrow C_nH_{2n} + nCO_2$$

All of the above reactions are exothermic, so low temperature and high yield pressure generally favor the per cent yield. A yield of 0.0106 pounds synthol per cubic foot of synthesis gas is obtained when nickel and cobalt catalysts are used at 370° F. and atmospheric pressure. Gaseous nickel carbonyl is formed at higher pressures, so deterioration is decreased by using nickel at one atmosphere.

Iron catalyst used at 465° F. and 150 *psig* pressure (medium-pressure process) gives a total yield comparable to that of nickel and cobalt. Higher-octane fractions are much more prevalent when iron catalyst is used due to olefin formation.

Nickel and cobalt catalysts were used almost exclusively in Germany in the normal-pressure process. Synthesis gas passed through one or more stages of reaction chambers, with or without recycle of the unconverted portion, and the heavier products condensed from the residual gas. Charcoal was used to adsorb the lighter products.

The relatively expensive loss of catalyst and the low-octane number of the resultant product in the normal-pressure process have caused most American firms to concentrate research on the iron catalyst, medium-pressure process. Using the medium-pressure synthesis, the catalyst de-activation is appreciably slower and an optimum yield of solid and liquid hydrocarbons is obtained. Among the many specific processes used in medium-pressure synthesis, the suspended catalyst and the fluid catalyst processes seem to be the most noteworthy.

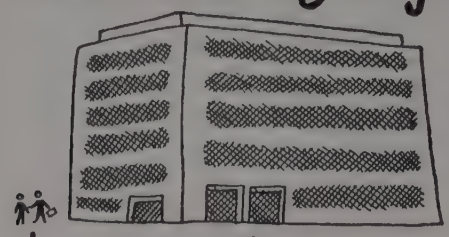
In the former process, finely-divided iron particles are suspended in a heavy oil medium, through which the synthesis gas rises countercurrent to the flow of the heavy oil. This gives the advantage of uniform-temperature control, in that the oil carries the reaction heat out of the reactor to a heat exchanger. A disadvantage is encountered, however, in that the reaction products are often difficult to separate from the heavy oil.

The fluid catalyst system is essentially a reaction chamber of finely divided catalyst suspended or "fluidized" in the up-flowing stream of incoming gas. The particles are in a constant state of violent agitation and transfer the heat of reaction to water pipes imbedded in the reactor walls. The many special difficulties encountered in this process include regulation of particle size, shape, and weight, and gas velocity. Gradual poisoning of the catalyst necessitates variation in feed of synthesis gas to the reactor so that the maximum yield may be obtained. The advantage of fluid catalysts are the intimate contact with the reacting gases and the close temperature control possible.

Although there are many variations and specific processes of the medium-pressure synthesis, a general flow system is usually followed. Reactors in the three stages are in a ratio of 2:1:1. Synthesis gas fed into the two reactors in the first stage has a H_2:CO ratio of 1.4:1. The liquid products are condensed in an indirect condenser, and the non-condensables are enriched with fresh synthesis gas to a H_2:CO ratio of 1.6:1, and charged into the second stage reactor. The liquid from the second stage is condensed in a like manner, and the effluent gas is enriched to 1.8:1 before entering the third stage. Products from the final stage are condensed in a direct water condenser, and C_3 and C_4 hydrocarbons are adsorbed in carbon.

Conventional petroleum methods are then used to separate and refine the gasoline, Diesel fuel, and fuel oil. By-product chemicals, consisting primarily of oxygen function compounds, are separated and processed for marketing.

No matter how big the job—



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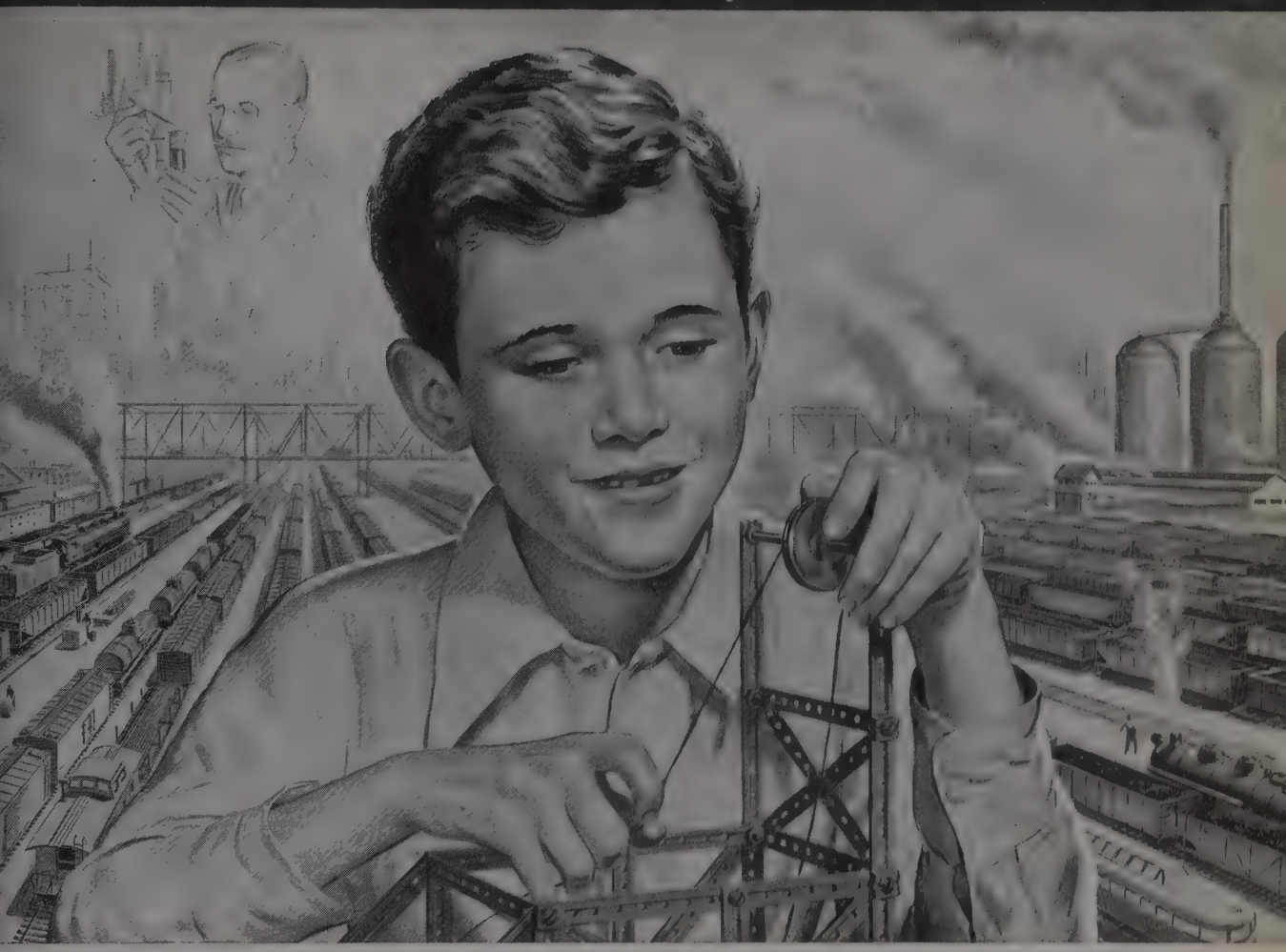


Why greater strength weighs less and less

CAN YOU MAKE three pounds of steel do the work of four . . . and stay on the job longer? The answer is YES, with *alloy steels*—steels that are combined with small amounts of other metals, such as chromium, vanadium, and zirconium, to develop or increase desired qualities. For example, it's the element, *chromium,* that gives the stainless nature to steel.

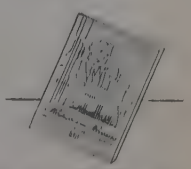
So great is the improvement in steel, when alloy agents are used, that a freight car of alloy steel can weigh 25% less, haul heavier loads, yet stay in service much longer than similar cars of ordinary steel. Alloy agents not only increase the strength of steel, they also extend its life through reduction of destructive factors such as rust, corrosion, and wear.

The use of better materials to make steel go farther and serve longer is especially vital to all of us . . . with steel mills unable to catch up, and ore supplies dwindling.

Industrial gases have a big role in steel's better performance, too. Compressed oxygen aids in cleansing the molten steel . . . the oxy-acetylene torch cuts steel sections to size—and welds them together if desired. Finished steel articles are given a harder, longer-wearing surface through "flame-hardening." And carbon, in the form of electrodes, makes modern electric furnaces possible . . . with their output of high quality steels.

The people of Union Carbide produce these and related materials for improving steel. They produce hundreds of other materials for the use of science and industry—to the benefit of mankind.

FREE: *Let us send you the new illustrated booklet, "Products and Processes," which shows how science and industry use UCC's Alloys, Chemicals, Carbons, Gases and Plastics. Just write*



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A backwoods woman, the soles of whose feet had been toughened by a lifetime of shoelessness, was standing in front of her cabin fireplace one day when her husband addressed her:

"You'd better move yore foot a mite, maw, you're standin' on a live coal."

Said she nonchalantly, "Which foot, paw?"

* * *

Then there's the one about the poor fella who caught his buddy making love to his girl. There was a lapse of silence and then he said, "I don't mind your kissing my girl, but get your hand off my fraternity pin."

Funeral Director (young and ambitious): "How old are you, sir?"

Aged Mourner: "I'm 98."

Director: "Hardly worth going home, is it?"

* * *

Barber: "What's the matter? Ain't the razor takin' holt?"

Victim: "Yeah, it's takin' holt all right, but it ain't lettin' go again."

* * *

I was struck by the beauty of her hand,
Then I tried to hold it, and—
I was struck by the beauty of her hand.

Greek Lesson No. 1

(*Overheard in an Athens tailor shop*)

Tailor: Euripedes?

Customer: Yas, Eumenides.

* * *

The Kentucky colonel always closed his eyes when he took a drink. When questioned on this habit, he readily explained, "The sight of good lickah, suh, always makes mah mouth water. An' I don't like to dilute my drinks."

* * *

Mrs.: "Here's my new dress, dear. I bought it for a song."

Mr.: "All right, send in the collector and I'll sing to him."

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for the engineering student interested in steam generation and related subjects

COMBUSTION ENGINEERING is probably the most comprehensive technical book ever published by an equipment manufacturer. Its 30-odd chapters and appendix run to well over a thousand pages and include more than 400 illustrations and about 80 tables. It is designed for the use of both engineering students and practicing engineers.

Among the subjects covered in this book are: the origin and production of coal; fuels for steaming purposes; fluid cycles; steam purification; feedwater; performance calculations; all types of stokers; pulverized fuel burning equipment; burners for liquid and gaseous fuels; furnaces for wood refuse and bagasse; all types of stationary boilers; marine boilers; forced circulation boilers; electric boilers; superheaters and desuperheaters; heat recovery equipment; drafts, fans and chimneys; selection of equipment; testing of steam generating units; and operation and maintenance of equipment. A full chapter is devoted to the A. S. M. E. Boiler Construction Code. The Appendix includes complete steam tables, and a Mollier Diagram is tipped in to the back cover.

Edited by Otto de Lorenzi, Director of Education, Combustion Engineering - Superheater, Inc. Size 6¼ by 9¼. 1042 pages.

HOW TO GET IT. Although the list price of this book is $7.50, it is made available to engineering students at a nominal price. For particulars see the head of your mechanical engineering department or your instructor in heat power. Inquiries may also be addressed to the publisher.

B-290

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A Merger of Combustion Engineering Company, Inc. and The Superheater Company

C-E

200 Madison Avenue, New York 16, N. Y.

The Ring Test

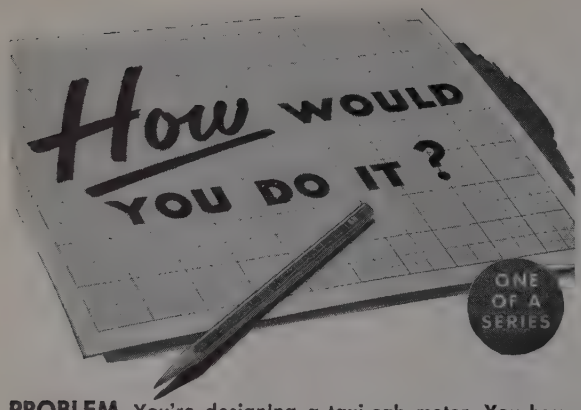
The ring test, shown above, is a scientific method for determining the modulus of rupture of pipe. It is not a required acceptance test but one of the additional tests made by cast iron pipe manufacturers to ensure that the quality of the pipe meets or exceeds standard specifications.

A ring, cut from random pipe, is subjected to progressively increased crushing load until failure occurs. Standard 6-inch cast iron pipe, for example, withstands a crushing weight of more than 14,000 lbs. *per foot.* Such pipe meets severe service requirements with an ample margin of safety.

Scientific progress in the laboratories of our members has resulted in higher attainable standards of quality in the production processes. By metallurgical controls and tests of materials, cast iron pipe is produced today with precise knowledge of the physical characteristics of the iron before it is poured into the mold. Constant control of cupola operation is maintained by metal analysis. Rigid tests of the finished product, both acceptance tests and routine tests, complete the quality control cycle. But with all the remarkable improvements in cast iron pipe production, we do not forget the achievements of the early pipe founders as evidenced by the photograph below of cast iron pipe installed in 1664 to supply the town and fountains of Versailles, France and still in service. Cast iron pipe is the standard material for water and gas mains and is widely used in sewage works construction. Send for booklet, "Facts About Cast Iron Pipe." Address Dept. C., Cast Iron Pipe Research Association, T. F. Wolfe, Engineer, 122 So. Michigan Ave., Chicago 3, Illinois.

Section of 285-year-old cast iron water main still serving the town and fountains of Versailles, France.

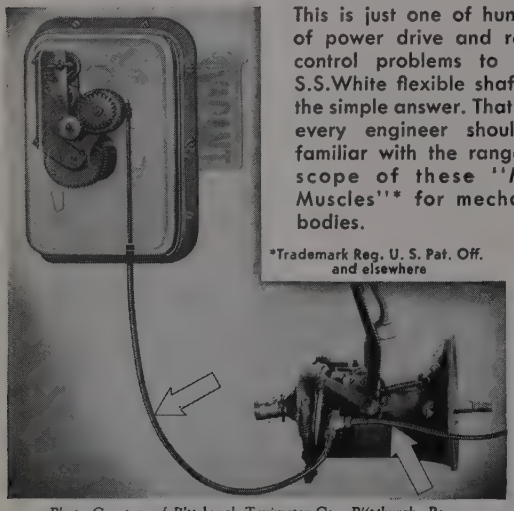
CAST IRON PIPE SERVES FOR CENTURIES



PROBLEM—You're designing a taxi-cab meter. You have worked out the mechanism that clocks waiting time and mileage and totals the charges. Your problem now is to provide a drive for the meter from some operating part of the cab—bearing in mind that the meter must be located where the driver can read it and work the flag. How would you do it?

THE SIMPLE ANSWER—Use an S.S.White power drive flexible shaft. Connect one end to a take-off on the transmission and the other to the meter. It's as simple as that—a single mechanical element that is easy to install and will operate dependably regardless of vibration and tough usage. That's the way a leading taximeter manufacturer does it as shown below.

★ ★ ★



This is just one of hundreds of power drive and remote control problems to which S.S.White flexible shafts are the simple answer. That's why every engineer should be familiar with the range and scope of these "Metal Muscles"* for mechanical bodies.

*Trademark Reg. U. S. Pat. Off. and elsewhere

Photo Courtesy of Pittsburgh Taximeter Co., Pittsburgh, Pa.

WRITE FOR BULLETIN 4501

It gives essential facts and engineering data about flexible shafts and their application. A copy is yours for the asking. Write today.

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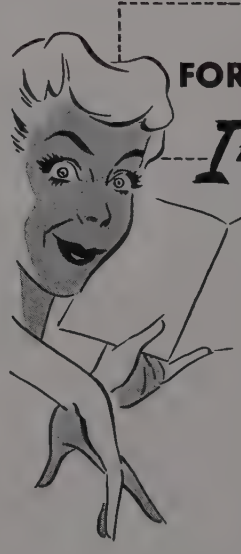

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SOCIETIES . . .

(Continued from page 15)

Officers for this semester were elected at a meeting held at the Foundry on January 4, 1949. The officers are chairman, Paul Green; vice chairman, H. Rodbro; secretary, Keith Van Ness; and treasurer, Joe David.

A.S.C.E.

More new officers for this semester were selected by the A.S.C.E. A nominating committee chose three candidates for each office and ballots were distributed by mail to the 320 members. The final count was taken on January 13, 1949, and the newly elected officers met with the retiring officers on January 15.

Those officers chosen for this semester are president, Wendall L. Rowe; vice president, John R. Anderson; secretary, Donald V. Sartore; and treasurer, Robert Mack.

KERAMOS

Keramos welcomed and initiated 13 new members at its December 8 meeting. The meeting and smoker were held at McKinley Hall. At this time the resolution of by-laws and proposed amendments to by-laws were discussed. A donation to the Campus Chest was also voted in.

Men initiated at this time were Bob Bender, Martin Berg, Jr., Charles Curtis, Jr., Lynn Fussell, Stanley Paspy, Jr., Henry Rapp, Jr., Norman Russell, Albert Siska, Harlan Tripp, John Cox, John Jero, Delmar Johnson, and Howard Rapp.

C.I.E.

One of the oldest and perhaps the least known of all engineering societies is the C.I.E. You are no doubt as surprised as I was to learn that there is a Chinese Institute of Engineers here at Urbana. You will be more surprised to learn that it has been on this campus for more than 10 years.

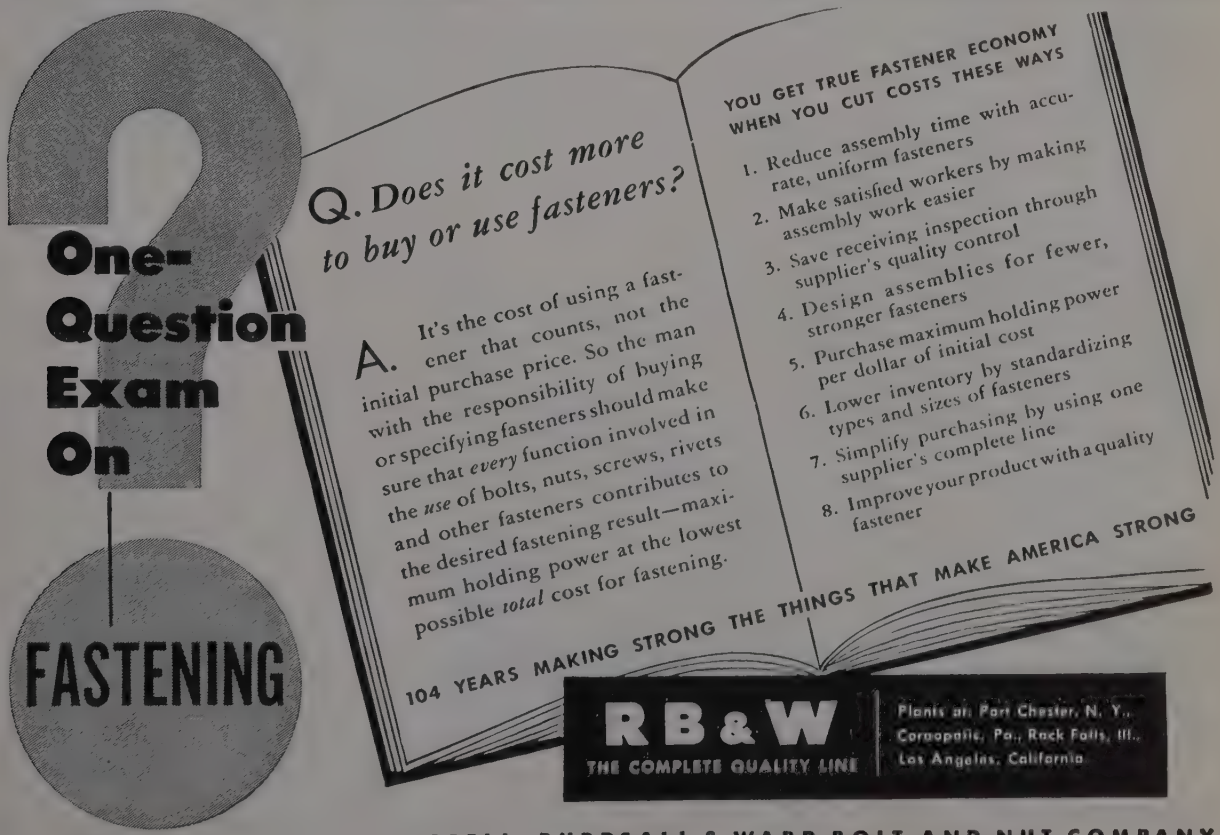
C.I.E. and C.A.A.S. (Chinese Association for the Advancement of Science, formerly known as the Science Society of China) are the two biggest academic organizations in China. The organization of C.I.E. is very much similar in nature to A.S.C.E., A.S.M.E., etc. in this country except that it covers the whole field of engineering rather than a particular phase.

In 1918, an informal Chinese engineering association was organized at Ithaca, N. Y., by some Chinese students of engineering at Cornell University. Later on, when those Chinese students went back to China, the association was formally combined with the Chinese Association of Engineers, founded in 1911. The combined organization is the presente C.I.S.

The C.I.E. branch in the United States was established in 1920 at New York City. The activities include presentation of technical papers during the annual meeting, publications of the C.I.E. Journal (a semi-annual publication), and the C.I.E. News Bulletin (bi-monthly). In 1937, chapters were founded successively at Ann Arbor, Boston, Buffalo, Detroit, Indianapolis, Ithaca, Philadelphia, San Francisco, Urbana, Milwaukee, Washington, D. C., and Montreal, Canada. C.I.E. Journal and C.I.E. News Bulletin are traditionally published by either the New York branch office or the Boston chapter. Membership in this country at the present time is roughly estimated at 750.

At the present time there are 80 members in the local chapter. Only 16 of these are working for their bachelor of science degrees. Twenty-nine are working for masters and 35 are working for Ph.D.'s. These men are engaged in nearly all phases of engineering.

The officers for this year are president, V. T. Chow; vice president, Andrew T. S. Yen; secretary, Charles C. S. Yen; treasurer, Arthur W. N. Lo; and business manager, Chi Lung Kang.


One-Question Exam On FASTENING
Q. Does it cost more to buy or use fasteners?
A. It's the cost of using a fastener that counts, not the initial purchase price. So the man with the responsibility of buying or specifying fasteners should make sure that every function involved in the use of bolts, nuts, screws, rivets and other fasteners contributes to the desired fastening result—maximum holding power at the lowest possible total cost for fastening.
YOU GET TRUE FASTENER ECONOMY WHEN YOU CUT COSTS THESE WAYS
1. Reduce assembly time with accurate, uniform fasteners
2. Make satisfied workers by making assembly work easier
3. Save receiving inspection through supplier's quality control
4. Design assemblies for fewer, stronger fasteners
5. Purchase maximum holding power per dollar of initial cost
6. Lower inventory by standardizing types and sizes of fasteners
7. Simplify purchasing by using one supplier's complete line
8. Improve your product with a quality fastener
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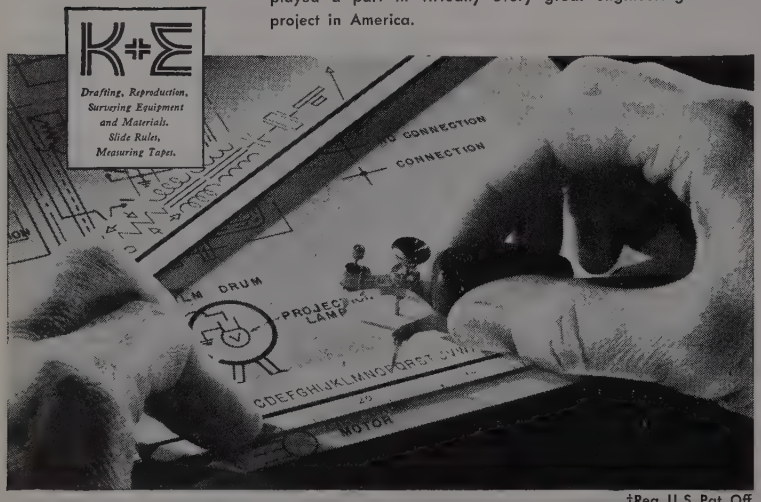

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SOUTH PACIFIC . . .

(Continued from page 7)

cent. However, the rains also solved another problem—that of moistening the coral, since in this wet state, it could be handled and set the most effectively in order to obtain a smooth hard-finish surface.

No one worried about such matters as bomb craters and the effect of the surprise air attacks; had the strips been of concrete, Seabee officials would have had good cause for worry, but with a coral air strip, it was a matter of having waiting truckloads of coral to be rushed out on the field after the all-clear signal. After being hand-shoveled into the patch and rolled down, the coral quickly united with the mother slab, leaving hardly a trace or scar behind. A subsequent sprinkling of salt water served to unite the coral better than fresh water, probably exercising anhydrous qualities.

Another construction item that became a piece of standard equipment in the South Pacific was the pontoon cell. Made of thin steel plates which were shipped flat and welded on the spot, the pontoon cell came in one general size of 5 x 5 x 7 feet. The method of assembly of the cells was fairly simple—cell fastened to cell by steel angles around the deck of each one.

Combinations of these cells served as bridges, drydocks for PT boats, small landing craft and seaplanes, self-propelling unloading barges, and wharfs for unloading supply freighters. With the addition of marine tractors, they have even been used as "tugs." An excellent example of their use as a wharf was the situation at a base in New Caledonia, center of the Solomon Island operations. A wharf was needed quickly for the unloading of badly needed supplies; however, time was scarce and the equipment for building such a pier was even more scarce.

A small crew of Seabees went to work and, putting in eighteen hours a day, turned out in record time a wharf 434 feet long by 40 feet wide—a wharf comprised of some 500 cells with rigid connections of three transverse joints on hinge connections with 1½ inch pins, thus allowing for free wave action. The wharf was held in place by mooring spars driven through thirty feet of water; the connection with shore was a series of "bridges" or groups of cells just wide enough for truck travel. This wharf was the first of its size ever built and served to pave the way for many more like it at other bases; for it had the advantage of being at home in practically every environment from atolls profusely spiked with coral reefs where ordinary piers would be out of the question, to rock-bound islands where other

(Continued on page 34)

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In the RCA television camera, for example, Synthane was selected for coil forms, tubes, flanges and other components because of its electrical insulating properties, especially at high frequencies and high voltages. Its ease of machining, light weight and structural strength were other factors that led RCA's design engineers to select Synthane as the best possible material for this job.

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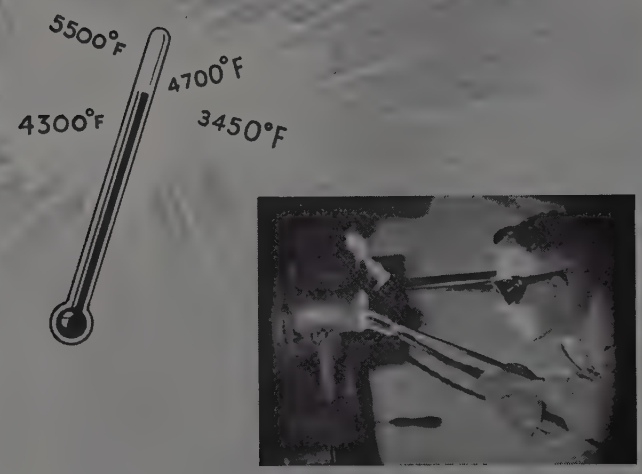

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SOUTH PACIFIC . . .

(Continued from page 32)

wharfs might be possible, but for the sake of time, not probable.

No matter how brief the resume of engineering operations in the South Pacific, a tribute to the Seabees and a brief explanation of their organization should be included. This offspring of the Civil Engineer Corps of the Navy was the answer to a Navy bottleneck in large-scale construction. Modern warfare methods demanded all manner of construction as well as the mass production of supplies and trained troops. No longer able to rely on civilian firms such as the PNAB after the outbreak of the war, the Navy needed their own construction corps, a highly organized army of men skilled both in the trades of construction and military tactics. This was the origin of the Seabees.

The usual Seabee recruits were men with experience in some phase of construction and generally a little older than the average draftee. Trained for actual combat and military engineering and given the largest and best construction equipment the Navy could dig up, these men turned out work in record time and on such massive scales that they have become sort of a legendary organization in the eyes of the American public. They also kept one eye cocked on projects where they could apply economy and ingenuity, instilled traits carried over from their civilian days.

Military divisions among the Seabees were the same as in the regular Navy. However, each company was divided up into highly specialized units, each of which had a definitely assigned job for each project. Although trained for the main purpose of land construction, the Seabees tackled whatever came their way, whether it was the repair and dry-docking of torpedoed ships or the building of a little village of straw huts for the native evacuees of enemy-held territory.

Although operating with greater freedom from military commands than other Navy divisions, the Seabee battalions worked under conditions that definitely placed them in the combat classification. Often, they began repairs on Japanese air fields or started entirely new construction on territory that was either listed as "battle zone" or enemy territory and that had not yet been decisively won by Army troops. Fairly true may be the old rag about a Marine, the first to land on the captured enemy isle of X, who found a Seabee lying on a sand dune and inquiring, "What's been keeping ya, Bub?"

ANSWERS TO VOCABULARY

1-c, 2-b, 3-a, 4-c, 5-d, 6-c, 7-a, 8-d, 9-b, 10-b, 11-b, 12-b, 13-c, 14-a, 15-d.

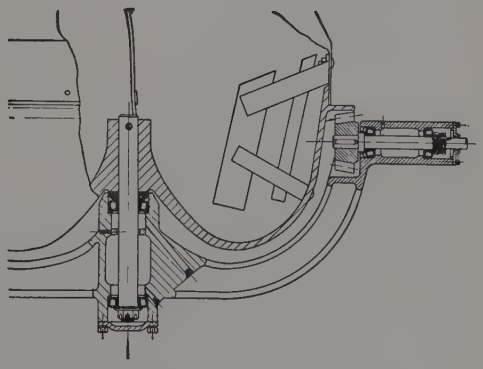
Another page for **YOUR BEARING NOTEBOOK**

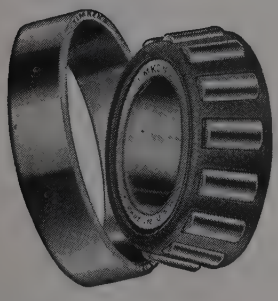
How TIMKEN® bearings pave the way for long life in a concrete mixer

Keeping concrete mixers from growing old too soon is the aim of construction equipment builders. That's why they use Timken® tapered roller bearings on drum shafts, driving pinions, and in the road wheels. Because Timken bearings practically eliminate friction and keep parts in rigid alignment, wear is reduced to a minimum.

TIMKEN® bearings keep gears meshing smoothly

This drawing illustrates how Timken bearings are used to insure smooth operation in a concrete mixer. Because of the tapered design, Timken bearings take thrust as well as radial loads. End-movement of shafts is eliminated and parts are held in rigid alignment. Timken bearings carry the heaviest loads with minimum shaft deflection. Gears wear longer—work better.





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ON THE CORNER OF WRIGHT AND GREEN

GALESBURG . . .

(Continued from page 18)

in conjunction with a vacuum tube amplifier. This vacuum tube amplifier causes the beam from a small crater lamp to vary in intensity according to the vibration of the phonograph needle. The resulting modulated light beam is focused, through a system of lenses, on a distant light collector which directs it to a photo electric cell. The photo electric cell transforms these variations of light into a series of electrical impulses which are connected to a loud speaker, which in turn transforms them into audible sound. This method of transmission is effective within a range of approximately 25 miles and has been adopted by the Navy for ship-to-ship communication.

The "House of Magic" show was very ably and interestingly presented by Mr. William Hoverman and his assistant, Mr. Roy Verlilis. Mr. Hoverman is a graduate electrical engineer from Brown university of the class of 1946. After graduation Mr. Hoverman accepted a position with General Electric in their test and research laboratories. Entering the commercial field after a year and a half in the laboratories, Mr. Hoverman became one of the lecturers who present the "House of Magic."

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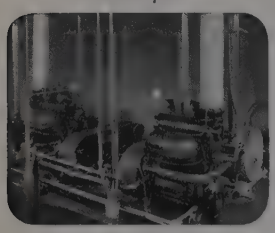

Two of Three Frick "New Eclipse" Machines at the Brass Rail

Three "New Eclipse" compressors provide 117 tons of refrigeration for air conditioning the restaurants of The Brass Rail, at 521 Fifth Avenue, New York. The installation, with its excellent results, is a credit to Armo Cooling and Ventilating Co., New York Distributors of Frick air conditioning equipment.

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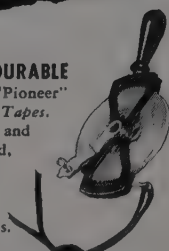

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DU PONT Digest
For Students of Science and Engineering

PRODUCING METALLIC TITANIUM FOR INDUSTRIAL EVALUATION

Du Pont group research developed a pilot plant with daily capacity of 100 pounds

Du Pont research has just made available to industry what may become one of America's key structural materials, titanium metal. Midway in density between aluminum and iron and with an especially high melting point, silvery-white titanium offers an extraordinary combination of strength, lightness, corrosion resistance and hardness.

Titanium is the ninth most common element. But it has been slow in coming into its own as a metal because of the difficulty of separating it in pure form from its ores.

Men pictured *on this page were members of titanium research team. E. L. Anderson, A.B.Ch., Brigham Young '40; J. B. Sutton, Ph.D.Phys.Ch., West Virginia '35; A. R. Conklin, M.S.Phys.Ch., Georgia '40, are shown inspecting 300 lbs. of Du Pont titanium metal sponge.*

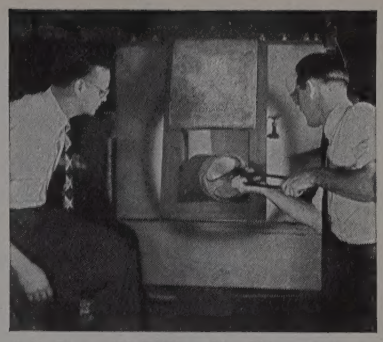
Du Pont scientists first began to probe the possibilities of metallic titanium in the course of their long experience with the titanium oxide pigments. Their research was interrupted by World War II. Meanwhile, the U.S. Bureau of Mines laboratories succeeded in producing the metal for research purposes.

After the war, Du Pont scientists developed a process for the production of ductile titanium metal that can be scaled up to meet commercial demands. The research team that mastered the complex problem consisted of chemical engineers specializing in design and production, as well as chemists and a metallurgist. In September 1948, a pilot plant was opened with a daily capacity of 100 pounds. Titanium metal is now being produced in sponge and ingot form. Samples are available to industrial and college laboratories with research projects in related fields. Studies of methods for forming, machining and alloying are under way.

Exhaustive studies will be necessary before the many possibilities of titanium metal can be known. Because of its high ratio of strength to weight, early uses may be in airplane power plants and structural parts. Its hardness and rust-resistance recommend it for railroad transportation equipment, marine power plants and propellers, and food packaging equipment. Its high melting point suggests use in pistons, and its resistance to electric currents points to electronics. Titanium wire may be used for springs and titanium sheet for such highly stressed parts as microphone diaphragms.

Your Opportunity in Research

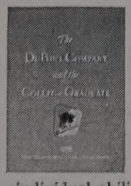
The commercial development of titanium metal is a typical example of Du Pont research in action. However, the Pigments Department, which worked out the process, is but one of the ten Du Pont manufacturing departments. Each conducts continuous research. Each is operated much like a separate company. Within these "companies"—whose interests range from heavy chemicals to plastics and textile fibers—college trained men and women work in congenial groups where they have every opportunity to display individual talent and capabilities. Who knows what their contributions will mean in the future to science and the world!



C. M. Olson, *Ph.D.Phys.Ch., Chicago '36, and C. H. Winter, Jr., B.S.Ch.E., Virginia Polytechnic Institute '40, removing 100-lb. titanium ingot from furnace in heat-treating study.*

R. C. Reidinger, *B.S.Ch.E., Princeton '47, and T. D. McKinley, B.S.Ch., Worcester Polytechnic Institute '35, making a test of the hardness of ingots of Du Pont titanium metal.*

THIS BOOKLET WILL HELP YOU PLAN YOUR CAREER



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WRITE TODAY for "The Du Pont Company and the College Graduate"

Smith, of Smith and Waverly, the well known manufacturers, hadn't taken a vacation in more than 20 years. He was finally prevailed upon to set out on a fishing trip. No sooner had he arrived than he immediately telephoned his office. Miss Jones, his secretary, spoke to him and told him that after his departure from the office the firm had received the largest order in its history. The order had been placed by telegram and Miss Jones started to read it to him. "Send immediately two hundred gross number 34 stop three hundred gross number 83 stop one hundred and fifty gross number 36 stop . . ." At this point Smith called out excitedly, "For heaven's sake, Waverly, leave that girl alone until she finishes reading me the telegram."

* * *

An engineer, who had a bottle of Scotch on his hip, slipped on the icy pavement and fell. On rising he felt something wet running down his leg.

"I hope it's blood," he said.

* * *

Foreman: "Hurry up, you guys, hurry up."

"Okay boss, but Rome wasn't built in a day."

Foreman: "Yeah, but I wasn't foreman on that job."

When the grocer's little girl came home after a holiday at her aunt's, she found that triplets had been added to the family.

"How silly of you, mummy," she said, "you should have done the ordering—you know daddy stutters!"

* * *

A spy was being led to his execution by a squad of soldiers on a cold rainy morning.

"You soldiers are barbaric," the doomed spy grumbled, "to make me march through this cold rain like this."

"Quit squawking," snapped one of the soldiers, "we've got to walk back."

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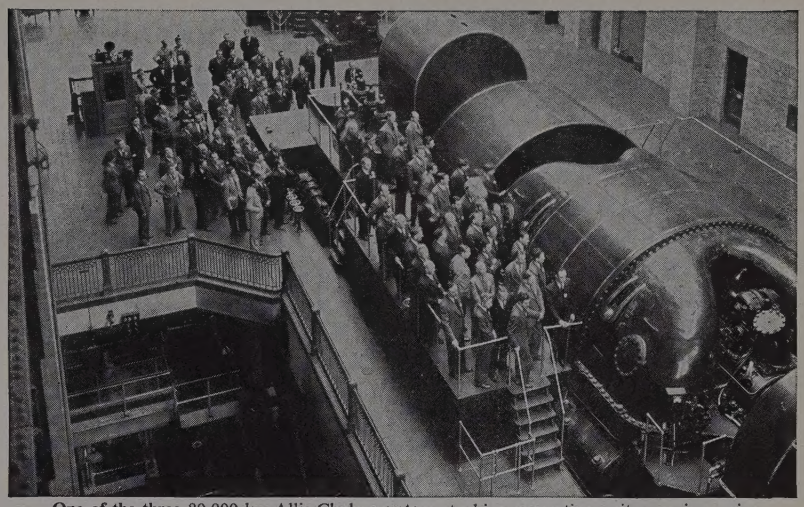
Change Your Mind...

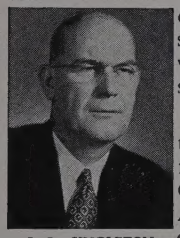
Most of us have, at one time or another

by J. L. SINGLETON
Vice-Pres. and Director of Sales, General Machinery Division
ALLIS-CHALMERS MANUFACTURING CO.
(*Graduate Training Course 1928*)



One of the three 80,000 kw Allis-Chalmers steam turbine generating units now in service in a big mid-western power plant. A fourth unit is being built, and a fifth is on order.

You may be one of those men who knows exactly the sort of work he wants to do when he finishes engineering school. I did. I was going into straight engineering work. But I became a salesman.



J. L. SINGLETON

I've noticed since that it's not unusual for Graduate Training Course students at Allis-Chalmers to change their minds. Here, opportunities have a way of seeking out a man according to his ability. Sometimes these opportunities are in fields that he had not fully understood or considered before. There are so many kinds of work to do here that a man is almost sure to end up in work that will bring him the most in personal satisfaction and advancement.

Opportunities in Selling

For example—sales. Not every engineer is a salesman, but at Allis-Chalmers every salesman is an engineer. Engineering plays a vital part in the sale of a big steam turbine, a cement plant—or even a multiple V-belt drive.

There's a thrill in landing orders—really big ones, such as two 115,000 HP generators for Hoover Dam—all of the rolls and purifiers for the world's newest and most modern flour mill—the world's largest axial compressor for use in a supersonic wind tunnel, or volume sales of small motors, pumps and drives. Orders like these come through teamwork of engineering, manufacturing skill, high-level salesmanship and merchandising. It's good to be a member of such a team.

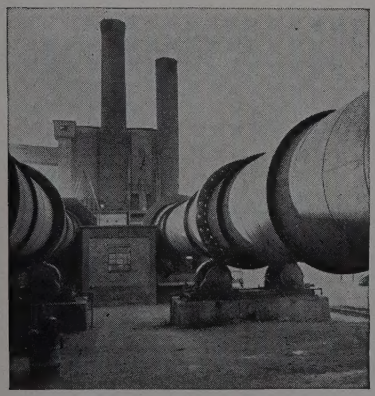
If you have ability and a leaning toward sales work, you'll have plenty of chance to test and develop it at Allis-Chalmers during your Graduate Training Course. Then you take your place in a Coast-to-Coast sales organization—perhaps even in a foreign office.

Many Fields Are Open

Or, maybe you'll change your mind. Research and development—or manufacturing—or design engineering may prove your field. The point I want to make is, all of these things are open to you at Allis-Chalmers. This company is in intimate touch with every basic industry: mining and ore processing, electric power, pulp and wood products, flour milling, steel, agriculture, public works.

The Graduate Training Course here doesn't hold you down. You help plan it yourself, and are free to change as you go along. You work with engineers of national reputation—divide your time between shops and offices—can earn advanced degrees in engineering at the same time.

Those are some of the things that appealed to me 23 years ago. They're still good.



Rotary Kilns are the most gigantic of all machines. Allis-Chalmers has designed and built kilns up to 475 feet in length, 12 feet in diameter—supplies all basic machinery for complete cement mills and processing plants.

Front-line man on the A-C team that designs, builds and sells basic machinery to all industry.

Write for details of the Allis-Chalmers Graduate Training Course — requirements, salary, advantages. Representatives may visit your school. Watch for date.

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VOCABULARY CLINIC

Remember, you won't be able to use these words until after you have consulted the dictionary for their pronunciation. From the group of words at the right, select one whose meaning most closely resembles the word on the left. Answers will be found on page 34.

1. Largesse—(a) very large, (b) very small, (c) a gift, (d) a container.
2. Nescience—(a) penetration, (b) complete ignorance, (c) nourishment, (d) magnificence.
3. Otiose—(a) useless, (b) a color, (c) graceful, (d) humorous.
4. Prefatory—(a) suitable, (b) poisonous, (c) introductory, (d) possessive.
5. Requite—(a) assure, (b) select, (c) dictate, (d) repay.
6. Verbiage—(a) an old verb, (b) grassland, (c) wordiness, (d) slaughter.
7. Ruminate—(a) ponder, (b) bring to light, (c) idolize, (d) delay.
8. Adjure—(a) reside, (b) imitate, (c) tell a story, (d) entreat.
9. Acrimonious—(a) stinging, (b) judicious, (c) plentiful, (d) ugly.
10. Nettle—(a) a small net, (b) irritate, (c) itemize, (d) offer for acceptance.
11. Behest—(a) a perfect specimen, (b) a command, (c) a forest, (d) take leave.
12. Cacophony—(a) music, (b) discord, (c) an imitator, (d) northern cactus.
13. Deference—(a) boldness, (b) loud talk, (c) consideration, (d) sly work.
14. Equivocal—(a) ambiguous, (b) equal, (c) monotone, (d) very clear.
15. Guile—(a) guide, (b) praise, (c) degrade, (d) deceitful cunning.

A fashionably dressed woman approached the florist and asked for some blooms. After the purchase she inquired:

"Will you be here next Wednesday, as I shall want some flowers for my daughter? She's coming out that day."

"She shall have the best on the market, ma'am," the salesman answered. "What's she in for?"

A burglar, who had entered a poor minister's house at midnight, was disturbed by the awakening of the occupant of the room he was in. Drawing his weapon, he said, "If you stir, you are a dead man. I'm hunting for your money."

"Let me up and strike a light," said the minister, "and I'll hunt with you."

—Hear about Bob being in the hospital?

—In the hospital? Why, I just saw him last night dancing with a blonde.

—Yeah! So did his wife.

* * *

Newly-wed Husband: "Do you mean to say there's only one course for dinner tonight? Just cheese?"

Wife: "Yes, dear. You see, when the chops caught fire and fell into the dessert, I had to use the soup to put it out."

* * *

Prof.—Don't you think you are straining a point in your explanation?

Stud.—Maybe I am, but you often have to strain things to make them clear.

* * *

"Did you give your wife that little lecture on economy you talked about?"

"Yes."

"Any results?"

"I've got to give up smoking."

* * *

Drunk (to splendidly uniformed bystander): "Say, call me a cab, will yuh?"

Splendidly uniformed bystander: "My good man, I'm not a doorman; I'm a naval officer."

Drunk: "All right, then call me a boat. I gotta get home."

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